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PENTOTHAL SODIUM ANESTHESIA USING AUTOMATIC CONTROL SYRINGE METHOD

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Pentothal sodium has not been so extensively used as it should have been considering the marked advantages that it possesses over other types of anesthetics. The three main advantages are safety, with proper administration, ease of administration and the fact that the patients like it.

Pentothal anesthesia has been held accountable for numerous deaths, and this fact has caused many to hesitate to use it. Investigation shows that practically all fatalities were due not to the drug, but to faulty administration or to the physical condition of the patient plus the choice of anesthetic. Many of these fatalities have been due to respiratory failure occurring when the anesthetic was administered without the essential safety equipment and without physical examination.

HISTORY

I first used pentothal in the early part of 1935, and only in selected hospital cases. At that time, little was known of its properties or dosage. All available literature recommended that it not be used in any type of mouth or throat surgery because of the danger of laryngeal spasm, with resultant respiratory failure.

Pentothal was first used in my office in 1936, and the total number of administrations including hospital has reached 12,463. There have been no deaths. Until 1940, local anesthesia and nitrous oxide-oxygen were used extensively, but, since that time, local anesthesia is seldom used and nitrous oxide-oxygen is used only on children for the extraction of deciduous teeth.

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UMI

I have developed an apparatus for administration of pentothal sodium that I have found to be easy to use, safe and economical. I have administered 3,512 anesthetics with this apparatus and I find that the cost of anesthesia has been greatly reduced. The recovery period is lessened and nausea is practically eliminated. Other advantages will be noted later.

PHYSICAL PROPERTIES

Pentothal sodium is a barbiturate, the sodium salt of ethyl thiobarbituric acid. It is a light yellow powder obtainable in 1 or 5 gm. ampules and is dissolved in sufficient distilled water to obtain the solution desired. The drug is thought to be eliminated by the liver, but with no apparent damage to that organ.

SYSTEMIC EFFECTS

The blood pressure usually rises during induction, then drops as much as 25 mm. in the normal individual. In hypertension, it may drop considerably more. Respiration is depressed and must be observed closely. The airway must be kept open. During the lighter stages, there may be a tendency to cough or sneeze or laryngeal spasm may occur. These conditions are corrected by clearing the pharyngeal area and deepening the anesthesia. There may be a marked increase in the pulse rate, but this decreases as the anesthesia deepens.

CONTRAINDICATIONS

1. *Hypotension.*—If the blood pressure is below 100 mm., the patient is referred to his physician, whose approval must be gained before the anesthetic is administered.

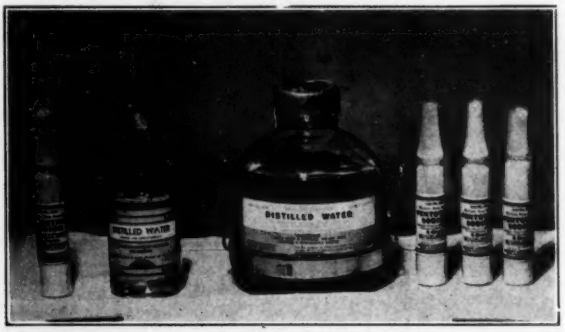

Fig. 1.—Ingredients for mixing pentothal solutions. Addition of three 5-gm. ampules to a 600 cc. container of distilled water gives a 2.5 per cent solution. Addition of one 5-gm. ampule mixed with 100 cc. of distilled water gives a 5 per cent solution.

2. *Degenerative Heart Disease.*—A greater margin of safety is secured by the use of a local anesthetic.

3. *Ludwig's Angina.*—If this condition is advanced, pentothal anesthesia is not advisable because of its action as a respiratory depressant.

4. *Shock.*—The patients in shock or who have lost a great amount of blood make up the group in which most of the fatalities have occurred. No anesthetic should be condemned for trouble arising from its improper use. Any anesthetic is dangerous in the hands of an anesthetist of unsound judgment.

5. *Child Cases.*—Pentothal has been administered by such men as Bullard and Brockett,[1] of San Diego, to children aged 1 year, with excellent results. My experience in such cases is limited. Nitrous oxide-oxygen is routinely used for children under 7 years because of the ease of administration in such cases.

PREMEDICATION

The only preoperative medicament found necessary in the great percentage of cases is atropine sulfate one one-hundredth grain. This is given routinely to reduce the flow of saliva and so help to keep the operative area dry. Its use also prevents excessive formation of mucus in the throat. In the

Fig. 2.—Pouring contents of pentothal ampule into distilled water. Stopper and metal cap are then replaced and sealed with adhesive tape.

1. Bullard, O. K., and Brockett, S. I.: Combined Pentothal Sodium-Nitrous Oxide-Oxygen Anesthesia in Oral Surgery. J. Oral Surg. 3:138-151, April 1945.

past, some sedative premedication was used in the office, but this practice has been virtually eliminated. It is still used in hospital cases because the recovery period is not so much of a problem and premedication does ease the fear of the trip to the operating room. The drugs used are morphine sulfate one-sixth grain and scopolamine one two-hundredth grain, given one-half to three-quarters hour before operation.

PREPARATION OF SOLUTIONS

At one time, it was thought necessary to mix a fresh solution before each case; and, if an additional amount were needed during the operation, a halt would be called and the needle would be removed from the vein and another ampule opened and prepared. This necessitated, among other things, the inconvenience of a new venipuncture.

This theory has been proved false, as the mixed solution is very staple.

Fig. 3.—Holder for autoclaving syringes and needles.

Many experienced users of pentothal, including such men as Olson,[2] of Hollywood, and Hubbell,[3] of Long Beach, mix the solution in large amounts and draw it from a container as needed. The San Diego Naval Hospital is a large user. There, solutions are mixed semiweekly. (Fig. 1.)

I use the 500-cc. size distilled water bottles, which always contain 600 cc. of water; cut the metal stopper holder, and remove the stopper, being careful not to break the glass air intake tube by hitting it against the side of the bottle. I then open three 5-gm. ampules of pentothal and pour the contents into the distilled water, then replace the rubber stopper and tube and seal

2. Olson, B. A.: Administration of Pentothal Sodium in Specialized Office Practice in Oral Surgery. J. Oral Surg. 1:197-207, July 1943.

3. Hubbell, A. O.: Intravenous Anesthesia in Dental Office. J.A.D.A. 28: 1039-1043, July 1941.

Fig. 4.—Full view of apparatus ready for use.

it with a strip of adhesive tape, cover the top with a sterile sponge and shake the contents until the powder is dissolved. (Fig. 2.) This method is easier and quicker and there is less chance of contamination than with the method of agitation by drawing in and ejecting from a syringe. This affords 600 cc. of a 2.5 per cent solution. One of these mixtures is made for each operating room.

From a 100-cc. bottle of distilled water, approximately 20 cc. of water is drawn off into a 20-cc. syringe. Another 5-gm. ampule of pentothal is opened and the water discharged into the ampule, the operator thoroughly dissolving the powder by drawing it back and forth with the syringe. When it is entirely dissolved, the solution is injected back into the 100-cc. bottle of water. This gives 100 cc. of a 5 per cent solution.

This solution cannot be prepared so easily by the previous method because it is very hard to remove the rubber cap of the 100-cc. bottle. If a different type cap can be secured, the first method will be employed for both solutions. The two strengths of solution are used because the stronger solution is considered preferable for primary induction. This will be discussed later.

PREPARATION OF SYRINGES AND NEEDLES

Immediately after use, syringes, needles and tubings are washed thoroughly with green soap and water. Needles are carefully checked for hooks and either sharpened or replaced. Ether is then run through them, being followed by distilled water. They are then placed in holders for autoclaving. (Fig. 3.) Each holder contains five syringes together with needles. Each compartment has holders for barrel, plunger and needle. The holder is a great time-saver as it eliminates the necessity of wrapping each syringe and needle separately. The syringes are 5-cc. ones with eccentric tips.

The rubber tubes are placed in their individual holders and are then autoclaved.

Each morning, two or more of the rolls of syringes are unwrapped, according to the number of expected cases for the day. A pellet of atropine sulfate one one-hundredth grain is placed in each barrel. The syringe is assembled and filled with 5 per cent pentothal out of the 100-cc. container. It is then agitated to dissolve the atropine and is placed in the various rooms in sterile gauze holders ready for use.

APPARATUS FOR ADMINISTRATION

The arm board, which is made of metal for strength and ease of cleaning, is detachable from the chair when not in use and is easy to replace. It is held in place on the chair arm by three rubber contact points and is tightened in place by a single adjustment on the side of the board. The top, or arm contact, board is adjustable both up and down and sidewise. When in proper position, it is clamped and held in place by one thumbscrew. A strap with buckle is used to secure the arm to the board. It is impossible for the patient to move enough to disturb the needle in the vein. (Fig. 4.)

The control syringe is attached to the arm board by a locking device and is easily accessible to both the operator and the assistant. This syringe is the center of the entire apparatus. By a series of valves, it automatically controls the flow of all solutions. (Fig. 5.) It consists of a metal case enclosing all valves, etc., the glass syringe with markings showing the amount of anesthetic in the holder. The plunger is encased in a waxed silk cover to prevent contamination of the syringe. There are two inlets on the bottom of the holder to permit the entry of additional solution of pentothal and a physiologic sodium chloride solution. An outlet protrudes from the nose of the holder to act as an adaptor for connecting to the rubber tubing leading from the syringe to the needle in the vein of the arm. When the holder is not in use, a cover containing cotton and alcohol is screwed over the tip to prevent contamination. The two inlets are connected by rubber tubing. One of the inlets is connected to the bottle of the physiologic sodium chloride solution and the other to the reserve container of pentothal, both attached to the wall. (Fig. 6.)

Fig. 5.—Control syringe; plunger being withdrawn in act of refilling.

Fig. 6.—Apparatus placed out of way in wall receptacle when not in use.

METHOD OF ADMINISTRATION

After the patient is prepared and placed in the chair, the arm is placed on the arm board and comfortably adjusted and secured by a strap. A tourniquet is placed around the upper arm a few inches above the elbow. (Fig. 7.) The antecubital fossa is sterilized with a 2 by 2 inch gauze sponge saturated with alcohol, and a suitable vein, usually the median basilic, is immobilized by pressure above and below the contemplated point of entry. This pressure is important in that it decreases the sensation of pain upon entry and prevents the vein from rolling. I use a 23 or 24 gage needle. With care and practice, venipuncture becomes extremely easy, with no discomfort to the patient. It can be accomplished from either side of the chair. It is easier in my case to reach across the patient. (Fig. 8.)

When the needle is in place, the tourniquet is removed and 3 cc. of the 5 per cent solution of pentothal is injected. During this time, the assistant places a piece of adhesive tape one-half inch wide and about 3 inches long across the needle and secures it to the arm. After a thirty to sixty second wait, the remaining 2 cc. is slowly injected. The assistant grasps the needle hub with a pair of Kelly forceps; the plunger of the syringe is drawn back slightly to determine that the needle is in the vein, and the syringe is removed from the needle.

The length of sterile tubing has been adapted to the nose of the control syringe by the assistant during venipuncture and filled with a physiologic sodium chloride solution that was allowed to run through the control syringe from the wall container. All air bubbles having been eliminated, the glass adaptor on the end of the tubing is placed in the hub of the needle and the tubing is taped to the arm. (Fig. 9.) The apparatus is then in use, the sodium chloride solution going through the needle into the vein. This prevents any possibility of clogging of the needle even when the smallest gage needles are used. Interposed in the tubing running from the control syringe to the saline solution container on the wall is a Murphy drip, the gage as to whether the needle is in or out of the vein, and a regulator of the flow. If the dripping stops, something has happened and the needle must be checked. (Fig. 10.)

If the patient requires more anesthetic, a cut off on the control syringe stops the flow of the sodium chloride solution, and the plunger of the syringe is pressed to inject the required amount of pentothal into the tubing. The cut off is flipped back and sodium chloride solution again runs through the line. This can be done with equal ease by the operator and the assistant. (Fig. 11.)

The 5 per cent pentothal is used for the first 5 cc. at induction because the smaller syringe is more easily handled during venipuncture, and the patient more rapidly loses consciousness and is not aware of any activity

Fig. 7.—Arm prepared for venipuncture.

Fig. 8.—Venipuncture made and slight amount of blood drawn into syringe to verify location of needle.

Fig. 9.—Syringe removed and replaced with adaptor on tubing leading to control syringe.

while the syringe is being replaced by the tubing. This is also the time to place any other restraint straps deemed necessary, and the patient will recover with no memory of having been tied down. In many cases of short duration, this primary injection is all that is needed. The patient might move slightly, but will experience no sensation of pain and have no recollection of the procedure. In such cases, recovery will be complete in a few minutes.

If additional anesthetic is necessary, the 2.5 per cent solution is used. The patient tolerates this much better and recovers more rapidly when larger amounts of anesthetic are necessary. Entry of this solution into the tissues is attended by no postoperative discomfort such as is experienced with 5 per cent solutions. There is no tendency to too deep anesthesia with the weaker solution. Additional anesthetic is given only when the movement becomes sufficient to interfere with the operator.

ADVANTAGES OF THIS SYSTEM

1. *Ease of Operation.*—When an anesthetic is to be given, there is no delay while someone unwraps a syringe, opens the pentothal ampule and mixes the anesthetic. The blood pressure and heart condition are checked and, if they are found normal, the tourniquet is placed, the venipuncture made and the anesthetic given, and often the operation is completed before the anesthetic could have been mixed by the old method.

2. *Ease of Administration.*—For many years before using this method, I had an anesthetist stand by the patient holding a syringe, constantly trying

Fig. 10.—Flipping control from vertical to horizontal position preparatory to injecting additional pentothal solution.

to keep the needle in the vein and trying to prevent its clogging. Every few seconds, she would draw back a little blood into the syringe to see if the needle was still in the vein and then inject a few drops of pentothal to clear it. There was always a tendency to deeper anesthesia than was necessary.

3. *Use of Physiologic Sodium Chloride Solution.*—The advantages of its use are many:

(*a*) A smaller gage needle can be used. This is greatly appreciated by the patient.

(*b*) There is no chance for blood to coagulate and clog the needle, as there is a constant flow of solution through the needle, keeping it clear.

(*c*) The fluid level of the body is kept constant, as the fluids lost by both perspiration and bleeding are constantly replaced. This is especially important in the longer operations.

(*d*) The blood pressure remains more nearly constant.

(*e*) There is much less chance of postoperative shock.

4. *Automatic Syringe Refill.*—There is no chance of exhausting the anesthetic during the operation regardless of the length of time. If the control syringe becomes empty, it is only necessary to withdraw the plunger of the syringe and the syringe immediately refills with the solution from the reserve tank.

5. *Recovery Period.*—This period is greatly reduced because there is less chance of deep anesthesia, which is not essential or desirable in dental work. Slight movement does not mean that the patient needs more anesthetic.

Fig. 11.—Injecting pentothal.

Fig. 12.—Nose adaptor in place and oxygen forced through nose and out mouth. The tongue forceps moves the tongue in and out to dislodge mucus and blood, which are then removed by an aspirator.

Even when all reflexes are present and the patient starts to talk, there is no recollection after recovery. Even in long-continued cases, the patient should move about while the last few sutures are being placed. By the time that the operating room is cleaned, most patients can walk to the recovery rooms. After a recovery period comparable to that with nitrous oxide-oxygen anesthesia, they are ready to leave the office.

6. *Expense of Anesthetic.*—The expense is only a small percentage of the expense of nitrous oxide-oxygen anesthesia, figured on either an hourly or a case basis.

The 5-gm. ampule costs approximately three times as much as the 1-gm. This saving of two-fifths in the original cost of the anesthetic is made by mixing it in larger amounts.

If a separate syringe is used for each case, the contents are contaminated when the blood is drawn back during venipuncture, and any part not used is wasted. With this apparatus, there is no anesthetic wasted, as only the minimum is injected from the control syringe, and any part of the usual 20 cc. ordinarily mixed that is not used is still in the wall container and saved for the next case. An accurate check of the expense per anesthetic has reduced costs 58 per cent in addition to the salary of an anesthetist to hold the syringe.

All of the experimentation on this apparatus has been conducted in the office, but a portable apparatus following the same principles for hospital use is now being designed.

CARE OF EQUIPMENT

All parts of the control syringe are either metal or glass. An extra control syringe is kept ready, together with connecting tubings autoclaved at all times; and, when a change is desired, the entire syringe, together with tubing and adaptors, is removed. The new adaptors are placed in the sodium chloride solution and pentothal bottles; the valve is set to allow the solution to fill the tubing; the plunger of the syringe is drawn back to withdraw air from the pentothal line until the solution appears in the syringe; the syringe is held with the outlet up, and the plunger is pushed in to eliminate the air. The plunger is then pulled back and automatically fills with pentothal from the wall container, and the apparatus is ready for use.

The apparatus that has been replaced is then cleaned, wrapped and autoclaved, and set aside for the next replacement.

These replacements are made about twice a week, although even then there is little need of replacement as there is no chance of contamination of the inside of the apparatus; but the glass plunger and barrel sometimes become hard to work because of constant contact with the pentothal solution and need to be cleaned.

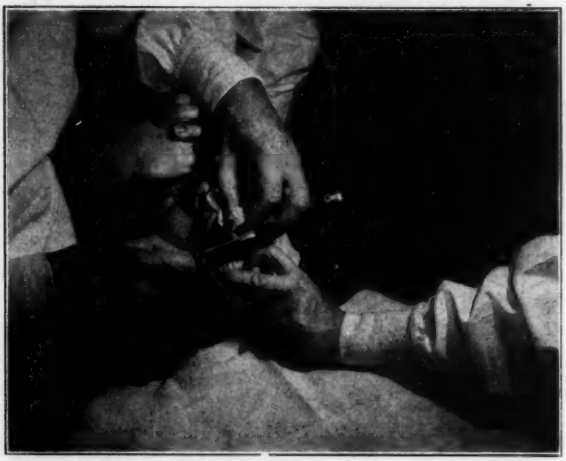

Fig. 13.—Placing suture through tongue in preparing loop to keep tongue forward.

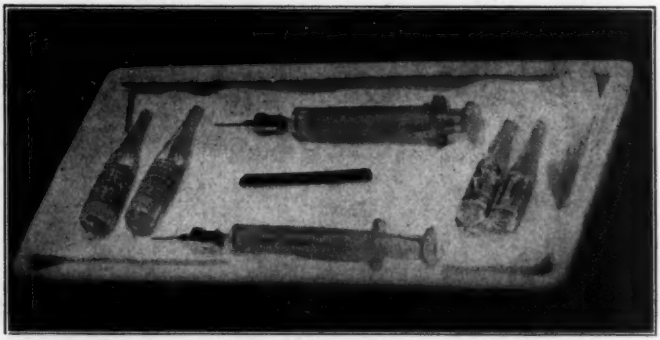

Fig. 14.—Emergency tray; syringes and drugs ready for instant use.

EMERGENCIES

No anesthetic should be given without having every means of resuscitation immediately available. The most important of these is a pressure oxygen machine, and administration of anesthetics without one will at some time have a fatal result.

Laryngeal spasm is the most common emergency arising from pentothal anesthesia. This is commonly brought on by the collection of mucus or blood in the pharyngeal area, and usually happens when anesthesia is light. It is easily overcome by administering a small additional amount of pentothal, then placing the nose adaptor on the face and forcing oxygen under

pressure through the nose and into the pharyngeal area. (Fig. 12.) At the same time, the tongue is brought forward and moved in and out to displace the mucus and blood in the throat. The oxygen will come out of the mouth and bring with it all the foreign material in the throat. This foreign material is then easily eliminated with the aspirator. If the operator so desires, oxygen can now be forced into the lungs, since the throat is clear and the oxygen can be forced in by covering the mouth.

A tendency of the tongue to drop back into the throat is easily overcome by placing a suture through the tongue, tying the ends together and placing a Kelly forceps near these ends. This simplifies the problem of pulling the tongue forward. The tongue is seldom sore and there is much less trauma than when a tongue forceps is used. (Fig. 13.)

Caffeine sodium benzoate, which is always available, is administered in case the anesthesia becomes too deep or the patient becomes exhausted. The dose, 2 cc., is easily given intravenously by injection directly into the rubber tubing just above the glass adaptor. Picrotoxin can also be used, 1 cc. intravenously as necessary. Coramine, 2 cc., is a powerful heart stimulant and can be given intravenously, intramuscularly or directly into the heart muscles. All these drugs should be kept in ampules on the emergency tray together with sterile syringes, etc., for immediate use. (Fig. 14.) They should be immediately available and, even though months may pass without trouble, the time will come when some of these drugs are needed and immediately.

CONCLUSIONS

In the great majority of cases, pentothal sodium is the most desirable anesthetic.

It is preferred by most patients because of its ease of administration and the pleasant sensations of both the induction and the recovery period.

It is easy to give and extremely safe when administered properly, and with the right type of equipment.*

416 Professional Building.

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*Relevant articles not referred to in the text:

Carraway, B. M.: Pentothal Sodium with Nasal Oxygen. Anesth. & Analg. 18:359, September-October 1939.

Bullard, O. K.: Intravenous Anesthesia in Office Practice for Operations in Exodontia and Oral Surgery. Anesth. & Analg. 19:26, January 1940.

Patterson, R. L.: Case Reports of Fatalities Following Intravenous Anesthesia. Anesth. & Analg. 20:225, July-August 1941.

Thompson, E. C.: Continuous Pentothal Sodium Analgesia, with Nerve Block, in Oral Surgery. J. Oral Surg. 3:205-211, July 1945.

SUBMAXILLARY ADENITIS, EMBEDDED TEETH AND DEVIATION DEFORMITY OF THE MANDIBLE*

EUGENE V. LINSEY, D.D.S., Cleveland, Ohio

History.—A woman, aged 28, when first seen complained only of a swelling in the lower right submaxillary region which had recurred over a period of five or six years without any pain or tenderness. The lower right first molar had been extracted eight or nine years earlier without complications.

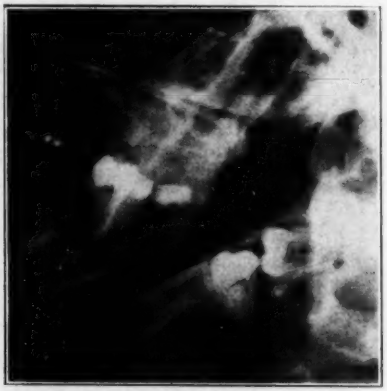

Fig. 1.—Lateral jaw roentgenogram, showing two embedded molar teeth and deformity of lower border of mandible.

Examination.—The patient appeared healthy in all respects, the only abnormality noted being an asymmetry in facial contour in the right mandibular area. The mandible appeared to be deviated to the right. The mouth opened normally and mastication was normal.

The lower right outline of the mandible was unlike that of a normal mandible. The inferior border directly below the molar region appeared to have been eroded away, and the inferior border of the mandible, instead of running posteriorly in a nearly horizontal line to the angle and then joining with the posterior border of the ramus, sloped upward and backward toward the condylar process at an oblique angle. (Fig. 1.)

The submaxillary swelling was firm, nontender and nonpainful. The area was not adherent to the mandible, but appeared to be "slung" below the mandible. The cervical lymph glands were not involved. The swelling did not cause discomfort.

*From the Dental Department of the Cincinnati General Hospital (Robert M. Schell, director).

Fig. 2.—Postero-anterior roentgenogram, showing embedded molar teeth and mandibular deformity.

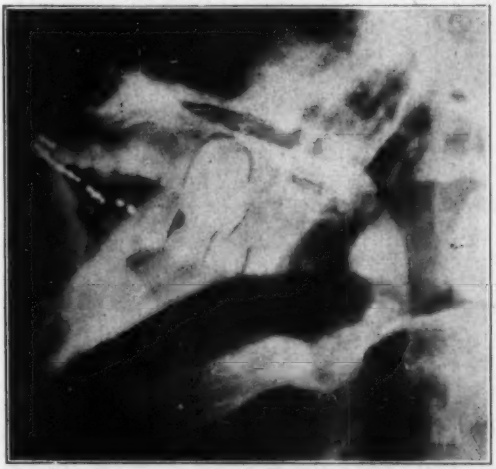

Fig. 3.—Postoperative lateral jaw roentgenogram, showing operative pathologic fracture.

The patient was wearing an acrylic full upper denture. In the lower arch, only the six anterior teeth were present. Oral hygiene was satisfactory. Figures 1 and 2 show malformation of the mandible on the right side. The second and third molar teeth were found to be impacted, as was the lower left third molar. The lower right second molar was vertically impacted, while the lower right third molar was horizontally impacted. Both the posterior-anterior film and the lateral jaw film showed that the bone surrounding these two impacted teeth was of almost "eggshell" thinness and that the outline of the jaw in the region of the lower right second molar dipped below the outline of the inferior border of the malformed mandible. Some pathosis was noted about the crown of the lower third molar.

Comment.—The lymphadenitis was probably due to impaction of the molar teeth and was chronic. The malformation of the mandible was believed to be due to a birth injury.

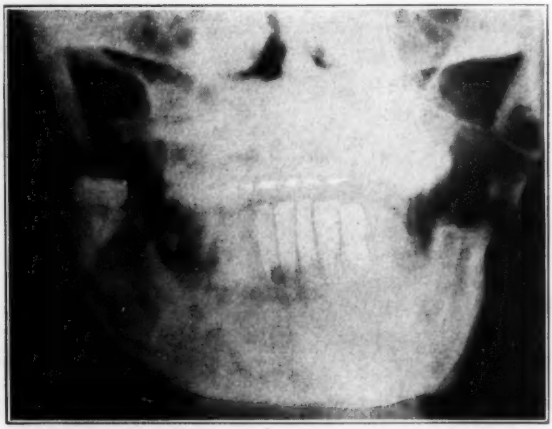

Fig. 4.—Postero-anterior roentgenogram, showing pathologic fracture with slight displacement.

Treatment.—Extraction of the two impacted molars on the right side and construction of an acrylic splint in anticipation of a possible fracture of the mandible on extraction of the teeth were prescribed.

Operation.—An incision was made along the ridge and carried posteriorly to the impacted third molar. The mucoperiosteum was then elevated and the overlying bone cut away with a straight osteotome. The bone about the occlusal and the buccal aspects of the second molar was removed and the tooth was extracted. On removal of the vertically impacted second molar, the apex of the root protruded through the bone and a small opening through the bone appeared at the base of the socket. Neither the artery nor the nerve was visible at this time. The bone was then removed from the occlusal and buccal aspects of the lower third molar, as well as some from the lingual aspect. The lingual

plate of bone was ankylosed to the third molar and, in order to remove the tooth, it was necessary to fracture the lingual plate. During this process, the remaining shell of bone was fractured. (Figs. 3 and 4.) The area was gently cleaned out and the soft tissue sutured. A splint made in anticipation of this fracture was not utilized.

Course.—The postoperative course was uneventful. Shortly after the teeth had been extracted and the fracture area had started to heal, the submaxillary lymphadenitis disappeared. Bony union was obtained and the sockets healed uneventfully. Before the teeth were removed, the swollen area was aspirated in order to determine whether there was pus present. None was found. The area of lymphadenitis appeared to be in the normal area of the submaxillary gland, but, because the mandible in this region was abnormal, the gland was found to be farther from the inferior border and the swelling appeared to be somewhat more remote from a dental origin.

Comment.—The cause of the abnormality in mandibular contour is not known. It may have been due to an injury at the time of birth, perhaps the slipping of forceps in delivery. With conservative treatment and without the use of any type of support such as chin straps or intra-oral wires or open reduction, the fracture healed normally.

310 Osborn Building.

Thrombophlebitis of Cavernous Sinus Following Extraction of Teeth.—Prior to the day of sulfonamide therapy, recovery from thrombophlebitis of a cavernous sinus was extremely rare. With the advent of these compounds reports of cures began to appear following the administration of sulfanilamide, sulfapyridine, sulfathiazole and, presumably, sulfadiazine. The use of anticoagulants, especially heparin, as adjuvant therapy seemed to enhance the value of the sulfonamide compounds, but this was by no means proved. Recovery from cavernous sinus thrombophlebitis with penicillin therapy has been reported. The case reported by Wiesenfeld and Phillips (*Arch. Otolaryng.*, 1944, p. 497) illustrates again the danger of performing an operation on the maxilla and the palate in the presence of acute sinusitis. Thrombophlebitis of a cavernous sinus developed in the presence of an adequate sulfadiazine level in the blood. A dramatic recovery followed the administration of penicillin and heparin.—Abstr. *Surg., Gynec. & Obst.*

SURGICAL REMOVAL OF DISPLACED THIRD MOLAR CROWN

ROBERT N. KNUTSON,* D.D.S., Pasadena, Calif.

The use of the elevator in removing impacted teeth can be advantageous. Unavoidable accidents can be eliminated by a conservative technic. In the case reported here, excessive force exerted by the operator on an elevator caused fracture of the crown, which was pushed back into the soft tissue.

REPORT OF CASE

History.—A man, aged 21, was transferred to the Pasadena ASF Regional

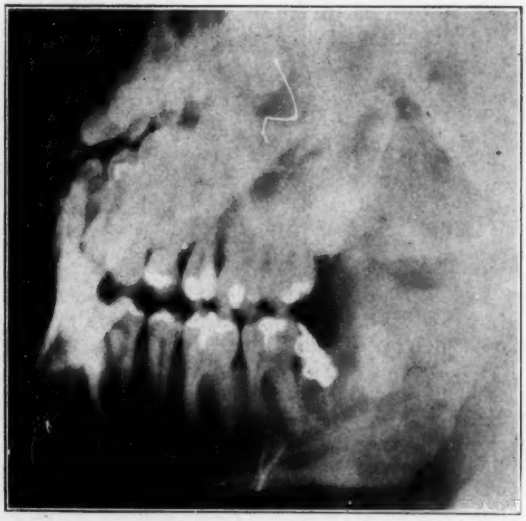

Fig 1.—Postoperative lateral jaw roentgenogram, showing displaced molar crown.

Station Hospital October 9, 1945, from another Army dental clinic. According to the transfer records, the accident occurred October 1, while an impacted left mandibular third molar was being removed. During elevation for removal of the impacted tooth, the crown broke off and was lost. It was found pushed distally into the soft tissues of the ascending ramus when follow-up x-ray films were taken. (Fig. 1.) Consultation with the dental officer revealed that the

*Major (DC) AUS.

Fig. 2.—Lateral jaw roentgenogram taken about ten days after extraction displacement. The crown was apparently situated at a lower level than is shown in Figure 1.

Fig. 3.—Vertex-mental x-ray projection, showing displaced crown situated considerably lingually from mandible.

postoperative course was stormy. For three days, the patient suffered extreme pain with a severe cellulitis of the left cheek, complete trismus of the mandible and a continuous fever which went as high as 103.5 F. The abscess that formed in the retromolar triangle was incised and drained, yielding one-half pint of pus. Penicillin, 50,000 units, was administered every three hours for eight days.

Examination.—Upon admission to the dental clinic at this hospital, a clinical examination revealed moderate trismus of the mandible, a slight submaxillary swelling of the left side and considerable trauma of the throat. X-ray films

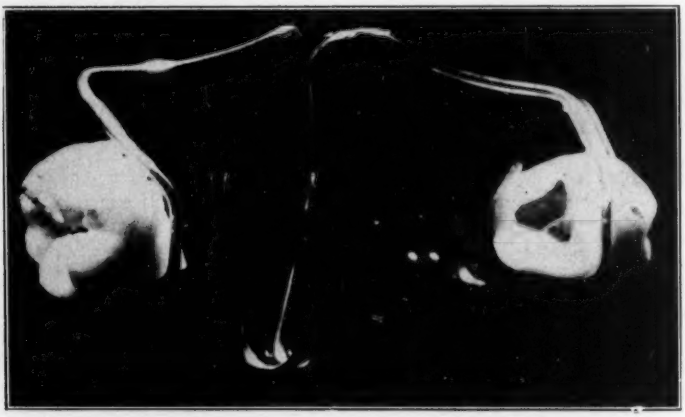

Fig. 4.—Occlusal and cervical views of third molar crown.

proved the crown to be in the soft tissues of the throat in the area of the angle of the ramus of the left mandible. (Figs. 2 and 3.)

Laboratory examinations on admission revealed: red blood cells, 4,950,000; white blood cells, 10,500; hemoglobin, 15.6 gm. differential count; neutrophils, 69; lymphocytes, 29; monocytes, 2. Urinalysis and Kahn test were negative.

The patient was instructed to use hot saline irrigations every hour. Twenty thousand units of penicillin was administered every three hours. A liquid diet was ordered and the patient was told not to talk in order to limit the movement of the muscles of the floor of the mouth, to prevent any further displacement of the crown. This preoperative course was continued for two days, at which time the patient was ready for surgical intervention.

Operation.—Premedication consisted of 1½ grains of pentobarbital sodium at bedtime the night before operation. Three grains was given two hours before and one-quarter grain morphine sulfate with one one-hundred-fiftieth grain scopolamine forty-five minutes before operation. The patient was given procaine 2 per cent with 1:50,000 epinephrine (mandibular injection to block the lingual nerve).

An incision was made along the linguogingival crest, extending from above the third molar socket to the medial aspect of the first molar. With a blunt

periosteal elevator, the mucosa was elevated supraperiosteally downward and backward until the crown could be located with a probe. The assistant stabilized the soft tissues of the throat to prevent the crown from being further displaced. No instruments were used in removing it, but, by finger pressure upward and forward, it was forced into view so that it could be picked out with a pair of cotton pliers. (Fig. 4.) The wound was then irrigated with penicillin and sutured.

Course.—The postoperative course was uneventful. Swelling was insignificant and the patient stated that he had no discomfort. Penicillin was discontinued on the second day after the operation. The patient was put on a regular diet on the third day and discharged to duty on the fifth day.

Pasadena Regional Station Hospital.

MISPLACED WISDOM TOOTH EXTRACTED DURING TONSILLECTOMY.
A. Mackenzie Ross.

A nurse, aged 43, suffered from an acute pansinusitis on the left side. Examination revealed septic tonsils and there was a history of occasional sore throat and quinsy on the left side. The sinusitis cleared up under treatment and, five weeks later, the tonsils were removed. The lower part of the left tonsil was found to extend laterally toward the mandible and, when it was dissected free, an abscess was encountered. Further exploration uncovered a hard black object, which proved to be a third molar tooth. On questioning the patient, it was found that, eighteen years earlier, an attempt was made to extract fourteen teeth under gas anesthesia, but anesthesia difficulties prevented the removal of all but seven teeth. Within a few days, quinsy developed on the left side. This was attributed to sepsis associated with the extraction. Several months later, the remaining teeth were removed under local anesthesia. The most probable explanation of this unusual case is that, during the first extraction under gas, the third molar was displaced lingually and, owing to the difficulty in getting satisfactory anesthesia, it could not be properly extracted. It was indeed remarkable that this tooth had lain dormant for eighteen years and had given rise to no local symptoms. The author attributed the sinus infection to an ascending infection from an abscess in the left tonsil beside the misplaced third molar.—*J. Laryng. & Otol.* 56:437-438, December 1941.

NEUROMA OF PALATE: REPORT OF A CASE*

GEORGE W. CHRISTIANSEN,† A.B., D.D.S., M.S., and
JAMES L. BRADLEY,‡ D.D.S., M.S.D., Bethesda, Md.

History.—C. R., a man, aged 55, had for the past fifteen years suffered from recurring attacks of severe paroxysmal pain in the right side of the face upward over the scalp and posteriorly to the parietal region. Months frequently elapsed between these onsets, but they had been more frequent in recent years, especially in 1941 and 1942 and during the present year.

A regular precursor of impending pain was an itching sensation on the labial surface of the lip in the maxillary cuspid region, and in the adjacent teeth and alveolar bone. Also there was slight edema of the right side of the naris and, around the right eye, edema that temporarily interfered with vision.

The duration of this syndrome was less than an hour and it was followed by intense discomfort, which persisted several hours. For the past five years, the attacks had begun in the evening around 7 o'clock, which made necessary an adjustment of the dinner hour. The use of alcohol was stopped, but without any effect.

Examination and treatment had been given in leading clinics of Berlin, Paris and Moscow. In 1937, roentgenograms of the teeth were made and nonvital teeth and third molars were removed. The patient noticed that the injection of a local anesthetic (cocaine hydrochloride, according to his report) in the roof of the mouth for the extraction of maxillary teeth gave relief from symptoms for long periods of time.

The nasal septum was operated on because of a spur, in 1914. The patient had pneumonia in 1914. The tubercle bacillus was found in the sputum in 1914. Herniotomy was performed in 1907 and 1930, and appendectomy in 1934.

Physical Examination.—The patient was well developed and did not appear acutely ill. Temperature, pulse and blood pressure were normal and ear, eye and nose examinations were negative. Examination of the mouth revealed an edematous-like red enlargement of the right side of the palate over the posterior palatine canal, which extended to the midline and anteriorly to the maxillary first bicuspid region. (Fig. 1.) This was tender to pressure and increased in size during an acuity test. The tentative diagnosis was hematoma or tumor of the palate in the vicinity of the posterior palatine canal.

Operation.—The mucoperiosteum of the palate was detached from the cervical margins of the teeth, from the incisors posteriorly to the tuberosity,

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*The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large. (Art. 113 [2] U. S. Navy Regulations.)

†Commander (DC) USNR.

‡Lieutenant Commander (DC) USN.

and a flap was lifted to permit an exploratory search for the cause of the swelling. Immediately after exit from the posterior palatine canal, the contents became entangled in a grayish white thick resistant semifibrous mass, which was loosely attached to the palatal surface. The growth measured approximately 1.5 cm. in diameter and was only slightly vascular. It was removed by dissection from the palatal flap as well as from the dense cicatrix over the canal lumen.

In the palatal bone under the tumor, a concavity was present, and this was bounded on its lateral side by a sharp irregular ridge slightly over 1 cm. in length. (Fig. 2.) This was reduced and the flap returned to position and

Fig. 1.—Edematous enlargement of right side of palate over posterior palatine canal extending to midline and anteriorly to maxillary first bicuspid region.

Fig. 2.—Irregular bony ridge slightly over 1 cm. in length.

sutured loosely. Five days after operation, swelling and pain developed. The border of the flap was lifted to drain a purulent accumulation and healing progressed without further delay.

Pathologic Examination.—Gross examination: The specimen consisted of small sections of irregular yellowish white pieces of tissue.

Microscopic examination: The section showed a few veins with hyaline thickening of the walls. There were concentric groups of cells, suggesting proliferation of the lamellar sheaths of small nerve bundles. These were surrounded by edematous connective tissue.

The primary pathologic diagnosis was traumatized veins.

Comment.—The neuroma is a rare type tumor of the palate. This case is of interest because of the long history of pain, which frequently simulated a trigeminal neuralgia, but in which, in spite of repeated examination, the tumor was not exposed surgically for inspection.

After relief from postoperative discomfort, the patient was entirely free from previous symptoms. The right and left sides of the palate were symmetrical.

Because the pathologic report did not agree with the clinical findings at operation, the opinions of other pathologists were obtained. These were not in agreement with the finding "traumatic veins," but concurred in the belief that the growth may have been a benign neuroma.

ETHICAL IDEALS FOR PROFESSIONAL MEN

The professional man should maintain a standard of competency in his own field, entirely apart from all considerations of public opinion or private gain. He may fall far short of his own standard, but he must never blur the distinction between good and poor work.

The professional man should consider his compensation, in whatever form it may be given to him, as a secondary end; and he should not only be content with a modest income, but also regard it as a part of his professional duty to make it clear to all concerned that a professional man is not interested in amassing wealth.

The professional man should take a personal interest in recruiting for his own and for other professions the most promising of the youth of the nation, and he should take a corresponding interest in the problems of professional education.

The professional man should deliberately cultivate honest criticism of his own and all other professional work, training himself to hate sentimental praise and ignorant faultfinding, and developing to the extent of his ability the difficult art of clear-sighted, constructive, critical judgment.

The professional man should regard himself as a guardian of the public interests in every situation where he finds those interests in jeopardy, because this is his first obligation to the society which has given him his professional education and opportunity.

The professional man should champion complete liberty of thought and expression, whether popular or unpopular, without yielding in the slightest degree his own convictions as to what is true or false, wise or foolish, right or wrong.

The professional man should encourage the experimental spirit in every department of human affairs, because he knows that all human progress has come about by this method.

The professional man should use every opportunity to promote better mutual understanding among men of different classes, creeds, nations and races, recognizing that his education and experience should enable him to rise above all fears and hatreds, and to serve as an interpreter and peace-maker among men.—Frederick M. Eliot.

OSTEOMA OF THE MANDIBULAR CONDYLE WITH DEVIATION PROGNATHIC DEFORMITY: REPORT OF CASE

H. G. Worman, D.D.S.; C. W. Waldron, M.D., D.D.S., and Dorothea F. Radusch, M.A., D.D.S., Minneapolis, Minn.

Benign osteogenic tumor, hyperostosis, exostosis and osteoma of the condyle of the mandible are of rare occurrence. Ivy,[1] in 1927, reported three cases and found but eighteen previously reported in the literature.[2] Since that time, but few have been reported.

The tumor enlargement tends to disorganize the temporomandibular joint structures and relationships and, as growth continues, the mass usually projects forward and internally beneath the zygomatic arch and away from the glenoid fossa. The ramus of the mandible becomes progressively lengthened, with resulting occlusal changes and deformity. There may be some symptoms of temporomandibular joint disabilities, but the malocclusion and external facial deformity may be the only significant clinical findings.

The case to be reported is of interest in view of the reestablishment of a fairly normal functional occlusion and the marked improvement in facial appearance after excision of the tumor.

REPORT OF CASE

History.—A woman, aged 24, seen in September 1936, complained of marked malocclusion, external facial deformity and recurrent locking of the jaw in open or closed position. (Figs. 1 and 2.) She stated that the condition had developed gradually over a period of six years and maintained that, at the age of 18, her facial appearance was normal and that her teeth occluded properly. There was a history of a fall down stairs at the age of 12, when she struck her face on the left side and was made unconscious for a short time. The history was essentially negative.

Physical Examination.—General physical examination revealed no departures from the normal. There was a perforation of the right ear drum, anterior inferior quadrant, but without discharge. The hearing was slightly impaired, particularly in the right ear.

Examination of the face revealed marked prognathism and deviation of the chin to the right with lengthening of the left side of the face, particularly of the left ramus of the mandible. There was obvious enlargement in the left malar-zygomatic region. Palpation of the right condyle revealed posterior displacement of the condyle head, and similar examination of the left side

1. Ivy, R. H.: Ann. Surg. 85:27-30, January 1927.
2. Gruca, A., and Meisels, E.: Ann. Surg. 83:755-767, June 1926.

Fig. 1.—Preoperative photographs, showing facial deformity due to osteoma of left condyle of mandible.

Fig. 2.—Preoperative malocclusion and prognathic deformity.

revealed the absence of a normal condyle in the glenoid fossa. The mouth could be opened wide, but lateral motion was restricted, particularly toward the right. Intra-orally, the mandibular incisors were forward approximately one-half inch and the midincisor line was displaced about one-half inch to the right. There was no effective occlusion. The lower first molar on the left side was missing. Otherwise, the teeth were in reasonably good condition. (Fig. 3.)

X-Ray Examination.—The posterior-anterior views of the facial bones (Fig. 4) demonstrated the prognathic deviation deformity, the lengthening of the left ramus of the mandible and the presence of a large bony mass in the region of the condyle. This bony enlargement was confirmed by the lateral jaw x-ray

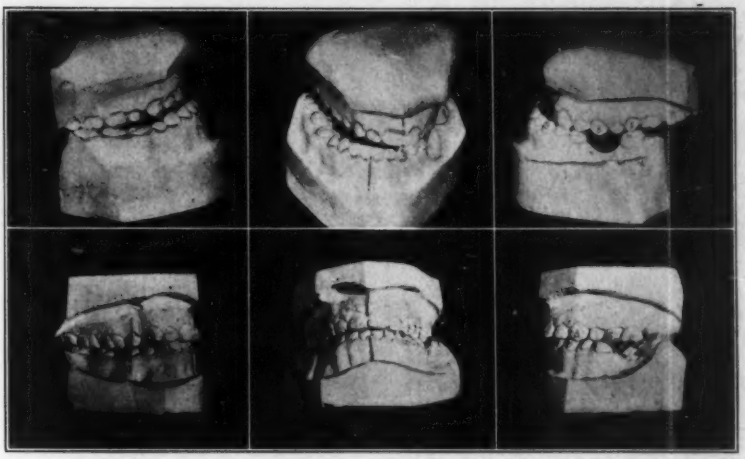

Fig. 3.—Casts, showing preoperative and postoperative occlusion.

Fig. 4.—Postero-anterior x-ray film, showing deformity.

picture. (Fig. 5.) Condyle x-ray studies (McQueen projection) showed that the right condyle was normal in size and appearance, but markedly retruded in the closed position. On opening, the forward glide was obviously restricted as it assumed the normal position for a condyle head with the mouth closed and, just behind and below the eminentia on the affected side (left), the glenoid fossa was seen to be empty, and the enlarged condyle head showed but slight change in anteroposterior position when the mouth was opened.

Diagnosis.—The diagnosis was benign osteogenic tumor of the condyle head of the osteoma type rather than exostosis, since there was an enlargement of the entire head rather than projections of a growth from an otherwise normal

Fig. 5.—Lateral jaw x-ray film, showing osteoma of left condyle.

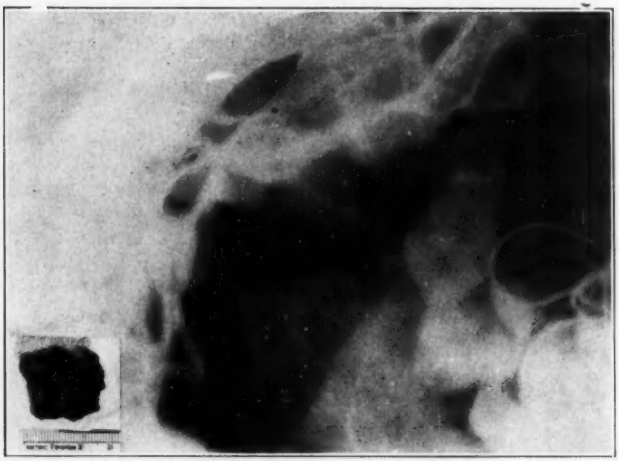

Fig. 6.—False joint produced by excision of tumor. Inset: Excised tumor.

appearing condyle. The bony structure did not show the dense characteristics of an exostosis, but rather the cancellous character, with regularity of trabeculations, of an osteoma.

Operation.—October 29, 1936, under intrapharyngeal ethylene and oxygen anesthesia, a vertical incision was made over the left temporomandibular joint extending upward 6 cm. from the level of the floor of the external auditory meatus. Cautious dissection was carried down through the temporal fascia. By watching the muscles to the face and eye, it was determined that the filaments of the seventh nerve were not severed. The temporomandibular joint

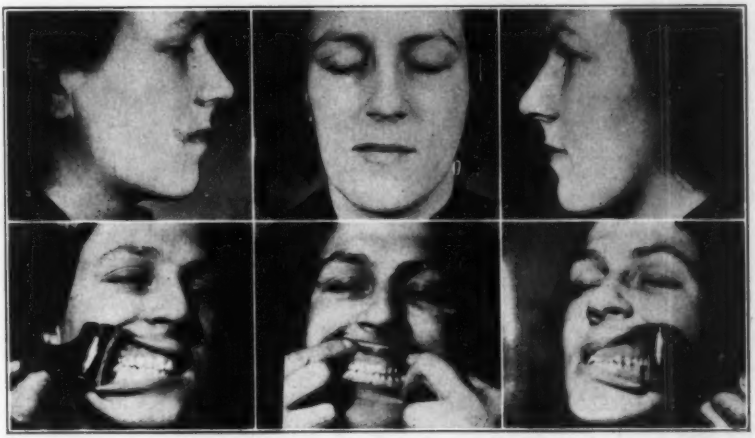

Fig. 7.—Postoperative photographs, showing correction of deformity and marked improvement in facial appearance and occlusion.

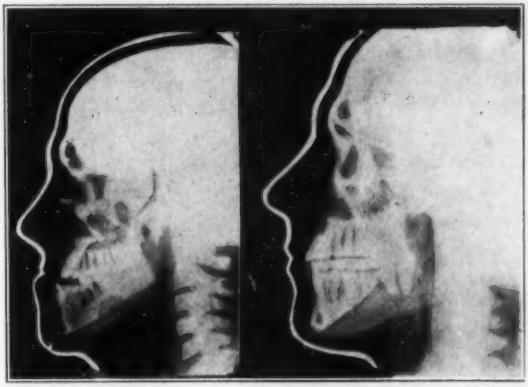

Fig. 8.—Profile x-ray films, preoperative and postoperative.

was opened, and dissection was carried down subperiosteally to the neck of the condyle. With a chisel, the neck was then severed, and an attempt was made to deliver the tumor of the head of the condyle through the wound. The bony mass was extremely large and it was found necessary to separate a section of the zygoma in order to deliver the bony tumor. Hemostasis was secured by multiple clamping and ligating, and the fragment of zygoma was replaced. The temporal fascia was closed with interrupted sutures of chromic No. 1 catgut. A wick of iodoform gauze was left in the operative defect. The skin was closed with interrupted dermal sutures. A dry dressing was applied. The patient left the operating room in good condition. The operative time was one hour and thirty minutes.

Course.—At the conclusion of the operation, the mandible could be manipulated without difficulty into relatively normal occlusion with correction of the prognathic deviation deformity. The improvement in the facial appearance was spectacular.

The teeth were wired in occlusion after the patient recovered from anesthetic and postanesthetic nausea. This wiring was maintained for several weeks.

The function of the jaw gradually improved, becoming essentially normal in the course of a month. Figure 6 shows the false joint after excision of the tumor. Examination showed that the occlusion could be improved by careful grinding of certain teeth that were interfering with occlusal balance, with resultant traumatic occlusion. This procedure was carried out over a period of several months and excellent functional occlusion was established.

The patient has been seen at intervals since 1937. At present, October 2, 1945, the occlusion is satisfactory. The mouth opens wide without the expected deviation to the left. Lateral motion is adequate although there is but a 2 or 3 mm. excursion to the right. There is good functional occlusion, although the patient is conscious of lack of strength on that side. Figure 7 shows the marked improvement in facial appearance and symmetry. The preoperative and postoperative profile x-ray films are shown in Figure 8.

COMMENT

Osteomas of the condyle should be treated by excision of the tumor and the production of a false joint which functions satisfactorily. Careful preoperative examinations and condyle studies should be made in all cases of prognathic deviation deformities of the mandible in order to differentiate between the tumor cases and the more frequently seen, but similar deformities of which the cause cannot be determined. Osteotomy of the ramus and setting back of the body of the mandible, so successful in these cases, are contraindicated in benign osteogenic tumors of the condyle. An immediate correction of the deformity might be secured by osteotomy, but the improvement might be but temporary since the tumor might continue to enlarge, with recurrence of the deformity.

Peripheral Nerve Surgery.—Evaluation of the results of peripheral nerve end-to-end sutures and the use of nerve grafts during World War I has been unsuccessful for many reasons, the most important of which have been the lack of uniformity in the examination of recovery of motor and sensory function and in the criteria to establish such recovery and, second, the lack of follow-up records of the patients. At present, there is a tendency to evaluate the results of grafts after periods of time far too short following operation. Six months or more frequently elapses following an end-to-end suture under ideal conditions before the first evidence of recovery occurs, and to expect evidence of recovery after the same period of time following the use of a homogeneous graft is expecting the impossible.—Loyal Davis, *Surg., Gynec. & Obst.*, April 1945.

MANDIBULAR OSTEOMYELITIS: ITS DIAGNOSIS AND TREATMENT

WILLIAM E. DURBECK, D.D.S., San Antonio, Texas

Casual retrospection on the history of osteomyelitis management reveals a rather barren era of empiricism until World War I. The years during and shortly after this conflict produced three methods of interest.

In the Carrel-Dakin drip technic, the area of pathosis was irrigated more or less constantly by a 1:1,000 solution of chloramine T. The Orr technic involved packing the wound with vaselin gauze and immobilizing the bone with a plaster cast. Postoperative attention was limited to vigorous supportive measures and disregard for the actual lesion except for an infrequent changing of the vaselin gauze dressings, with a resultant stench not easily tolerated. The Baer method was essentially the introduction of sterile maggots into the area for the purpose of active and constant débridement of necrotic material.

The use of sulfonamides in association with surgical intervention has been of service in the treatment of acute osteomyelitis, but has left much to be desired. In March 1943, Florey predicted that the time would come when osteomyelitis treated early and intensively with penicillin would not require surgical intervention. Before the presentation of a more modern version of treating mandibular osteomyelitis, it may be well to review the clinical, pathologic and roentgenologic aspects of the disease.

Mandibular osteomyelitis may be hematogenous but it usually occurs as a result of trauma and infection introduced from the outside, as in the case of a compound fracture, tooth extraction or gunshot wound. The odontogenesis may be pericoronal, periodontal, periapical or residual.

In any event, the clinical picture is consistent. Pain usually is manifest first in intermittent flashes, soon replaced by a dull, gnawing ache. A one to three degree elevation of temperature is fairly constant at the onset, but precedes a septic curve characterized by an evening rise and morning fall with a latitude as great as four or five degrees. A stiff, boardlike swelling, which becomes fluctuant as pus approaches the surface, tends to cause severe trismus, probably from an inflammatory contraction of the masseter muscle. Cervical adenitis, particularly of the superior cervical chain, is the rule. Should the pathosis be characterized by copious pus formation, the deep and superficial fascial planes of the neck may be involved. The

1. Durbeck, W. E.: Surgical Consideration of Lateral Pharyngeal Space. J.A.D.A. 30:1083-1088, July 1, 1943.

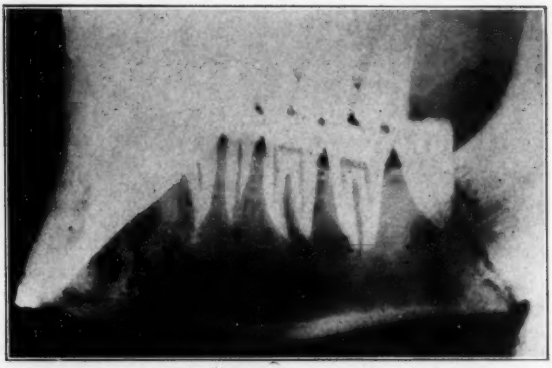

Fig. 1.—Early roentgen evidence of osteomyelitis. The area immediately mesially from the fracture line and in the region of the mandibular foramen has sustained loss of the trabecular architecture and presents regions of decreased density. The film has been purposely underexposed so that the more delicate areas will not be "blacked out."

deep cervical fascia may become involved by dissection into the lateral pharyngeal space and thence inferiorly around the carotid sheath.[1] Evacuation of pus, either spontaneous or surgical, tends to relieve pain and decrease fever. I am unable to support this view in mandibular osteomyelitis, but it is Trueta's opinion that suppuration usually occurs at that part of the bone which has no muscular attachment.[2]

Laboratory procedures during the acute stages of the disease will reveal 15,000 to 25,000 leukocytes per cubic millimeter with 85-95 per cent polymorphonuclear neutrophils. In prolonged cases of debility, the Arneth count may disclose a "shift to the left" in the incidence of immature cells. In such cases, there may also be anemia due to the destruction of erythrocytes and the associated hemoglobin by bacterial toxins. The blood culture may or may not be positive, but consistently positive cultures are indicative of an unfavorable prognosis. Equally grave are plate cultures which exhibit eight or more colonies per cubic centimeter of blood. Key, abstracting 697 cases of osteomyelitis in the literature, contends that a staphylococcus, usually hemolytic *Staphylococcus aureus,* is the offending organism in 90 per cent of cases, *Staphylococcus albus* being comparatively rare. Streptococcic infections are a poor second, with pneumococcic and mixed infections following in order of frequency.[3] Specifically, Key's breakdown shows:

Staphylococcus, 623.

Streptococcus, 35.

2. Trueta, J., Principles and Practice of War Surgery. St. Louis: C. V. Mosby Co., 1943.

3 & 4. Key, J. A.: Orthopedic Subjects (Subcommittee on Orthopedic Surgery of Committee on Surgery of Division of Medical Sciences of Natural Research Committee). Philadelphia: W. B. Saunders Co., 1942.

Pneumococcus, 18.
Mixed staphylococcus and streptococcus, 16.
B. typhosis, 4.
B. influenzae, 1.

Consideration of pathologic development may be relevant. The organisms are brought to a fixation point by either outside contamination or blood stream deposition. With multiplication of the colony, endotoxins are created, which permeate the adjacent bone, cellular necrosis, coagulation of plasma, death of leukocytes and hemolysis of the erythrocytes resulting. Thrombosis occurs with retarded circulation, while, in proximal areas, smaller vessels dilate to permit the usual defense by the leukocytes and mononuclear cells around the bacterial focus. While some of the cocci are

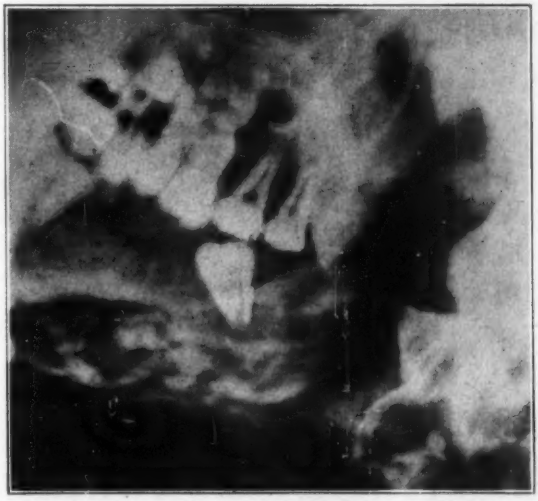

Fig. 2.—Moth-eaten pattern of destruction characterizing well-established osteomyelitis.

phagocytosed by leukocytes, destruction of the leukocytes by toxins releases proteolytic enzymes or ferments, which digest and liquefy dead tissue. Connective tissue which survives tends to proliferate in an effort to wall off the area. The process follows the lines of least resistance, but eventually penetrates the cortical plate to elevate the periosteum and form a subperiosteal abscess. Key holds that tissue death is not due to the ischemia of static circulation, but to excretion of toxins by staphylococci.[4] It is interesting to note that pathogenic organisms may be walled off, to become dormant for many years after the lesion has healed clinically; which possibly gives rise to the saying: "Once osteomyelitis, always osteomyelitis."

Roentgen identification, since it is impossible until from seven to ten days after the onset, is usually of value only as a means of verifying clinical diagnosis. The earliest roentgenographic evidence is marked by disturbances in the intra-osseus architecture, in which medullary spaces enlarge and coalesce, with trabecular destruction. (Fig. 1.) As the disease progresses, the picture is characterized by a diffuse, moth-eaten pattern (Fig. 2), portions of which tend to necrosis. These necrotic areas often contain considerable areas of deposition of calcium, which become highly radiopaque. Attempts at sequestration follow. (Fig. 3.) In order to follow the course of the disease and to record its progress, a series of films should be made at regular intervals. In it will be shown an attempt at new bone formation by the natural defense mechanism of the patient. This single factor of

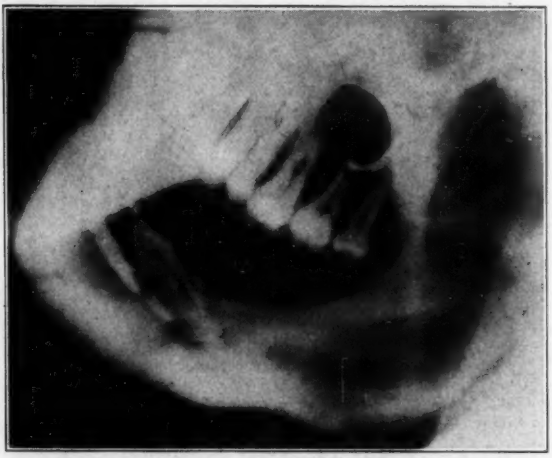

Fig. 3.—Sequestration in advanced osteomyelitis. The sequestra are more highly calcified than normal bone.

simultaneous destruction and production of bone is pathognomonic of the disease and is of diagnostic import. The scattered areas of deposition of new bone often lend a thickened, irregular appearance to the roentgen image. (Fig. 4.) Unless the infection is extremely virulent or the patient is neglected, destruction will most likely be limited to one mandibular body, as bilateral involvement or destruction of the rami occurs less frequently. As the roentgen picture is similar to that of some malignant areas, differential diagnosis is important. Malignancy is not attended by sequestration except when there is coincidental infection; or after radiotherapy. Furthermore, there is malignant destruction of the cortex as a unit and not of several separate areas as in osteomyelitis.

Current literature on the management of osteomyelitis concerns itself to a greater degree with the aspects of treatment than with surgical procedure. Penicillin and sulfonamide therapy dominate all other interests. In treating osteomyelitis of the facial and cranial bones, Williams and Nichols use 44,000 units of penicillin daily in 2 liters of physiologic sodium chloride solution by the intravenous drip method.[5] Kirby and Hepp suggest more heroic measures, advocating an intravenous drip of 200,000 units each day for ten days or two weeks, then 120,000 units intramuscularly each day for two or three weeks. Their recommendation is that surgical measures be postponed three or four weeks from the onset till sequestration has occurred,

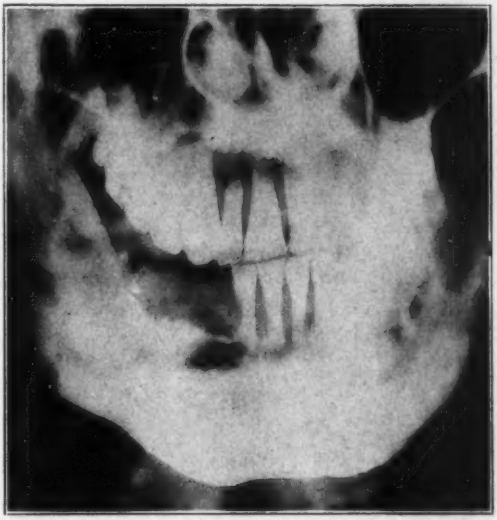

Fig. 4.—Deposition of new bone throughout mandible resulting in thickened irregular appearance.

so that there is a greater possibility of removing all devitalized bone at one time.[6]

Chemotherapy broadens the field of the sulfonamides to be chosen. Sulfanilamide is not the drug of choice because a lowering of the patient's general resistance results from its toxic side action and, in therapeutic doses, no effect on the staphylococci can be anticipated. Sulfathiazole, being polyvalent, offers more effective possibilities. This may be administered

5. Williams, H. L., and Nichols, D. R.: Spreading Osteomyelitis of Frontal Bone Treated with Penicillin. Proc. Staff Meet. Mayo Clin. 18:467, December 1, 1943.

6. Kirby, W. M., and Hepp, V. E.: Treatment of Osteomyelitis of Facial Bones with Penicillin. J.A.M.A. 125:1019-1022, August 12, 1944.

by mouth or intravenously as a sodium salt, although, if the latter method is selected, care must be taken to prevent extravasation into the surrounding tissues as alkaline necrosis may occur. Since penicillin is now favored for systemic use, use of the sulfonamides is best restricted to local application as an adjunct to surgical operations. Hurrell likes finely powdered sulfathiazole and considers sulfadiazine and sulfapyradine locally irritating to certain tissues, particularly the periosteum. Sulfanilamide he considers effective only against hemolytic streptococci and therefore too limited in therapeutic efficacy.[7] Hurrell's stand is vulnerable on two counts: First, sulfathiazole, relatively insoluble as compared with sulfanilamide, may not be absorbed and presents the possibility of foreign body reaction from the residue. Secondly, local application of the sulfonamides does not have a

Fig. 5.—Preferred site for external incision, following inferior border of the mandible, in this case slightly lingually to prevent disfigurement. The area immediately below the incision was earlier drained of pus. The photograph was taken eight days after surgical care. The dotted line indicates the extent to which the incision could have been safely continued. The approximate location of the external maxillary arteries is shown.

strictly *in vivo* reaction as many *in vitro* characteristics are present. The *in vitro* aspects of sulfanilamide therapy include action against the staphylococci.

In the practical management of mandibular osteomyelitis, early recognition is of prime importance and prompt penicillin therapy of sufficient intensity is indicated. Improvement in appetite and general well-being may

7. Hurrell, Wallace: Penicillin and Sulfonamide Therapy in Management of Compound Injuries. Lectures on Reconstruction Surgery, Selected for Instructional Courses of 12th Annual Assembly, American Academy of Orthopedic Surgeons. Ann Arbor: Edwards Bros., Inc., 1944.

be anticipated, not as a side action of the drug, but as a result of control of the infection. Administration of 100,000 units intramuscularly each day up to a 2,500,000 unit total has given satisfactory results and aborted excessive bone destruction, so that surgical treatment was not required. Those cases which, from inadequate treatment or late diagnosis, present roentgen evidence of more advanced conditions are treated similarly until such time as definite sequestration may be demonstrated. At this time, surgical intervention is instituted.

An external approach is preferred to eliminate contamination from oral fluids; and because the area adjacent to the inferior border of the mandible is largely devoid of any important vessels or nerves, this site is selected. (Fig. 5.) The external maxillary artery, if severed, is amenable to ligation, and the incision may be extended posteriorly far enough to give access to the ramus. The dissection is carried to the bone at the indicated site and continued until access is provided. The periosteum is now stripped back both lingually and buccally until the diseased portion in its entirety is uncovered, at which time all offending tissue is removed with rongeurs and curets. After complete débridement, the cavity is filled with finely powdered sulfanilamide and the wound closed with dermal sutures without packs or drains of any sort. With reasonable surgical judgment, healing of the incision by first intention occurs in most cases. Others usually require nothing more than supportive treatment and dressing changes. Penicillin therapy is continued for two or three weeks after surgical treatment.

SUMMARY

1. Prompt recognition and treatment of osteomyelitis are imperative.[8]

2. The roentgen picture of osteomyelitis may be differentiated from that of malignant destruction.

3. Penicillin given early and intensively is the agent of choice for systemic therapy.

4. Sulfanilamide may be indicated locally. The recent summaries of accumulated war experience, in general, discount the introduction of any chemical agent into a wound for its supposed antiseptic effect.[9] This concept is more particularly applicable in the management of war wounds for which the local use of chemotherapeutic agents has been abandoned.

5. Surgical measures are indicated when significant sequestration is observed in the roentgen series.

6. An external approach is preferable to prevent contamination from the oral fluids.

823 Medical Arts Building.

8. Altemeier, W. A., and Helmsworth, J. A.: Penicillin Therapy in Acute Osteomyelitis. Surg., Gynec. & Obst. 81:138-157, August 1945.

9. Notes on Care of Battle Casualties. Bull. U.S.A. M. Dept. 4:245-265, September 1945.

CARE OF THE SURGICAL PATIENT

G. Victor Boyko, D.D.S., M.S., Paterson, N. J.

The dental training afforded the student today indicates a continued advancement in keeping with the general progress of the times. The predental course, in addition to the postgraduate and graduate programs, presents opportunities for study in every phase of dentistry. There is evidence at present of the approach of a time when hospital internships for the dental graduate will be available in every large hospital on a national scale. Even dental residencies will be offered to the dentist in many hospitals, for encouraging graduate training and research work. The dental department in the hospital, simulating the medical department, will not only include surgery, but also every other phase of dentistry and will be under the head of a dental director, who will hold a major staff position in that hospital. The American College of Surgeons and the National Hospital Association have conceded the need of such departments. It is now only a matter of details and time to complete the plan.

With peace again prevailing, schools, hospitals and dental societies may now concentrate on teaching to advance dentistry. Much has been gained from war experiences. These profits will contribute to the improvement of dentists and dentistry. The collaboration of physicians and dentists working in units among servicemen is only the start of a plan which may be continued in civilian practice for common benefit to medicine and dentistry.

The dental student today receives a basic medical training as related to dentistry. This is particularly essential to the practice of surgery about the jaws. There is only one type of surgery, whether one deals with the extraction of a tooth or an extensive osteomyelitis. The same principles of pathology and bacteriology are involved and death may result in either instance. Likewise, the same moral and legal responsibilities are assumed in any form of procedure about the jaws, whether it be performed by the general practitioner or by one limiting his field to one phase of dentistry. Malpractice suits instituted against dentists verify this fact.

Surgical technics change slowly. Chemotherapy has brought about many changes in therapeutic procedures for the care of diseases. The advent of the vitamins, sulfonamides and penicillin has added considerable knowledge and has effected changes in the treatment of dental infections. For this reason, every dentist is obligated to keep pace with the advances made by means of postgraduate studies. This will result in fewer complications and better results in practice.

Every patient entering the dental office for any form of surgical care

will require a preoperative examination, including history taking, modified to suit the circumstances. Even though the examination is brief, thoroughness should be implied, to instil confidence in the patient. Time and experience improve the sense of perception and judgment, so that much may be accomplished in a short time. Certain direct questions may encourage the patient to tell his personal history without fear or apprehension. "Are you taking any medicine at present?" or "Are you under medical care?" will often yield good returns. A question pertaining to shortness of breath may reveal a cardiac history and indicate the anesthetic most suitable for the patient.

In the physical examination, the eye quickly notes the outward characteristics of the patient and observes possibilities of anemia, a thyroid condi-

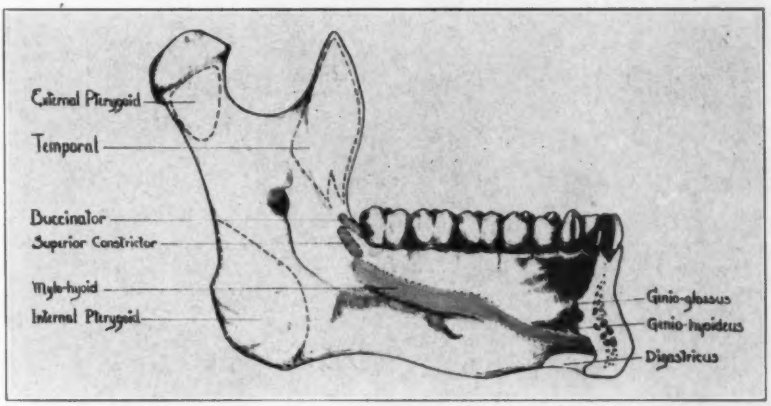

Fig. 1.—Relationship of buccinator, superior constrictor and mylohyoid muscles to alveolar ridge.

tion or hypertension. The age should always be known for obvious reasons. Psychopathic tendencies should be noted. Intra-orally, one perceives, in a short time, the tone of the mucous membrane, ulcerations or congested areas simulating either primary lesions or symptoms secondary to such systemic conditions as diabetes, anemia, blood vascular conditions or blood dyscrasias. Tuberculosis and syphilis may have oral symptoms. It is essential to make biopsy studies of lesions possibly malignant. The simple procedure of sectioning a small part of the lesion for microscopic study may save a life.

The examination, in conjunction with the x-ray study, will determine the necessity for further medical consultation or a plan of continued care by the dentist. Patients with a history of bleeding following extraction of teeth should have a blood coagulation or bleeding time test. Those with

symptoms of anemia may require a blood count. The diabetic may have a urinalysis prior to any surgical treatment. The dentist may have these examinations made and so determine the need for additional study. Every dental office should have a thermometer for temperature reading in addition to an emergency kit, within easy reach, for coping with circulatory or respiratory embarrassment. In the presence of symptoms of respiratory infection, the temperature should be taken prior to inhalation anesthesia. The use of a thermometer will also help to eliminate the class of patients who invariably develop a "cold" or spasm of vomiting on the day of operation.

The results of the preliminary examination of the patient and the condition under consideration determine, first, whether hospitalization is required and, second, what type of anesthetic is most suitable. The type of anesthetic selected for the office patient also determines the premedica-

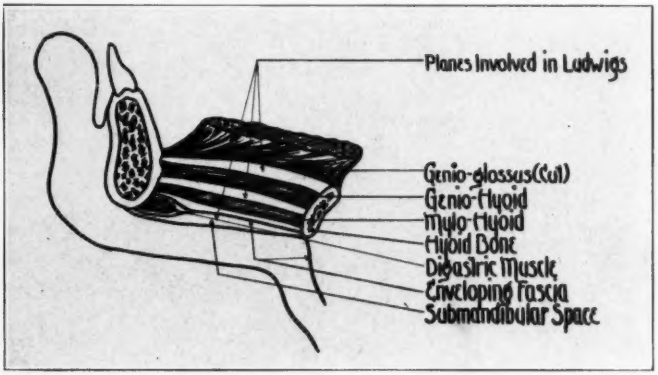

Fig. 2.—High lingual attachment of genioglossus muscle.

tion. In the office, the patient receiving a general anesthetic seldom takes preoperative medication because of the necessity of a hypodermic injection. The hospitalized patient has this advantage over the ambulatory one.

It is good judgment to prepare the patient for every surgical procedure. The cardiac and hypertensive patient may require preoperative and postoperative rest in addition to sedation. The diabetic patient should have the sugar metabolism under control, while the thyroid and anemic patient may need preoperative care. In lesions from foci of infection, preoperative and postoperative sulfonamide or penicillin therapy may be required for control of potential systemic conditions resulting from possible liberation of organisms into the blood stream following the extraction of teeth. The collaboration of physician and dentist will determine the form of treatment.

In the absence of any organic lesion, the dentist selects the necessary sedative or hypnotic for preoperative medication. Both the operator and the patient benefit by such a procedure. The common drugs utilized in such procedures are codeine, morphine, the barbiturates, bromides, aminopyrine and acetylsalicylic acid. A combination of a hypnotic and a sedative proves quite effective. The dentist should have capsules made of selected drugs for preoperative medication. A combination of codeine and phenobarbital, sodium pentobarbital or aminopyrine and phenobarbital has good results. A relative or friend should accompany the patient to the office when preoperative sedation is to be given.

Surgical treatment within the oral cavity is associated with more hazards than that in other parts of the body because of the surface bacteria encountered. The presence of Vincent's spirochete, the fusiform bacillus and cocci leads to complications. The dentist should treat the oral cavity to reduce

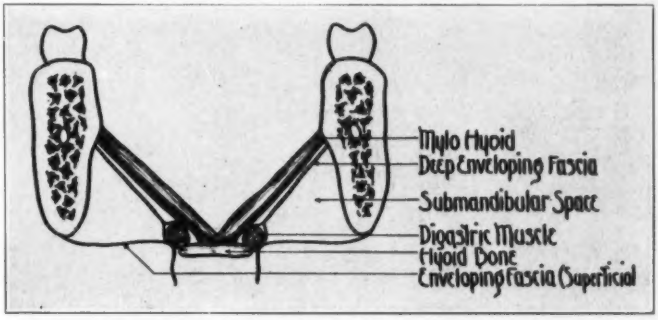

Fig. 3.—High position of mylohyoid muscle on lingual plate of mandible.

the number of vicious organisms in order to operate in as clean a field as possible. Smears from tissue areas suspected of infection will often be required to eliminate doubt. Many postoperative complications and much suffering may be avoided by the use of smears. In addition to maintaining a clean surgical field, minimizing tissue trauma and clearing wounds of tissue débris will have good results.

Of importance to the dental operator is muscle esthetics. The dentist performing a surgical operation should appreciate the fact that attachments of the muscles of the edentulous mandible and maxillae are definitely related to successful prosthesis, which means satisfaction in the postoperative period. The mandible presents as related muscles the mentalis, buccinator, genioglossus, mylohyoid and superior constrictor. The maxillae present the buccinator and the closely related caninus, nasalis and depressor alae nasi, in addition to the labial frenum. (Figs. 1-4.) Damage to these muscle

attachments by surgical measures should be minimized. If disease has destroyed the bony attachments of these muscles, these areas should be sutured to avoid contraction of scar bands and adhesions. Drains and rubber tissue may be utilized to avoid tissue contraction.

The types of drains used in wounds are gauze, vaselin or iodoform, rubber tissue and many sedative compounds. These drains may be infiltrated with the sulfonamides in crystal form or saturated with penicillin. Repeated change of drains every few hours may be indicated. Whether a drain is necessary and the type of drain to be used depend on the location and depth of the wound in addition to the type of infection under treatment. After the greater percentage of tooth extractions, there is a clean wound requiring no drainage. The areas remaining after the removal of partly

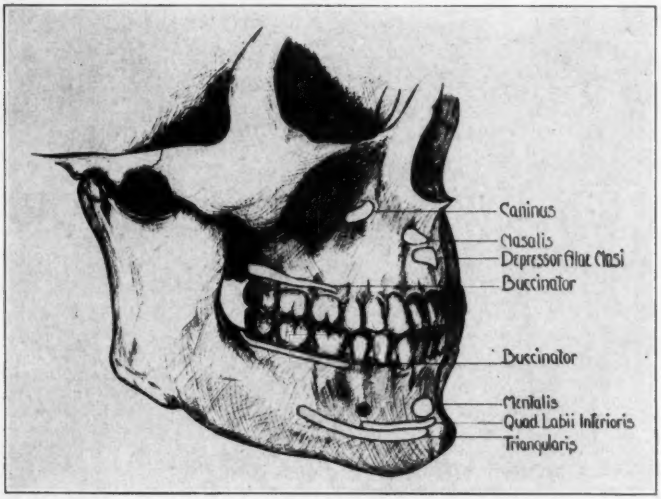

Fig. 4.—Muscle attachments to buccal plates of maxilla and mandible. These are more numerous than the attachments to the internal alveolar margins.

erupted third molars previously treated for infection frequently require drainage as a prophylactic measure. The local use of the sulfonamides and penicillin with or without drains depends on the judgment of the operator.

Postoperative edema, pain and tissue swelling are in proportion to operative trauma and resistance of tissues, local and systemic, to surgical injury and bacterial invasion. Patients may be told to expect the usual results. Sedatives, cold applications and a gargle, with rest, are prescribed, to combat these symptoms. These directions are given not only to the patient, but also to the person accompanying him; or the instructions may be presented

in typed or printed form. The sedative and hypnotic will be required to relieve pain and to insure rest, which is necessary for recovery. Elevation of the head usually reduces discomfort. In order to help the edentulous patient mentally and physically, a dietary list is given covering the caloric intake to be maintained until mastication is restored by the construction of dentures. This list, which will also encourage increased feeding during the edentulous period, has an educational and physiologic effect on the patient. The dietary is given in the accompanying table.

DIETARY

		Calories
Cereal, two servings		125
Cream, 40%		480
Eggs, two		150
Fruits, pulp and juice (tomato juice included)		500
Milk, one quart		670
Sugar or lactose		150
Vegetables, pureed, two servings		50
	Menu 1	
6 a.m.	Orange and grapefruit	75
8 a.m.	Pineapple juice, arrowroot gruel, milk and cream, sugar	280
10 a.m.	Fruit whip, cream	160
12 noon	Cream of celery soup	200
	Apple sauce, cream	160
2 p.m.	Tomato juice, cream	135
4 p.m.	Eggnog	200
6 p.m.	Cream of tomato soup	250
	Cup custard	175
8 p.m.	Cocoa	200
	Menu 2	
6 a.m.	Tomato juice	75
	Prepared barley gruel, milk and cream, sugar	240
8 a.m.	Grapefruit juice	75
	Oatmeal gruel, milk and cream, sugar	260
10 a.m.	Banana milk shake	175
12 noon	Beef soup, with two vegetables pureed	100
	Boiled custard	150
2 p.m.	Fruit whip, cream	160
4 p.m.	Pineapple eggnog	220
6 p.m.	Cream of asparagus soup	200
	Junket	200
8 p.m.	Hot malted milk	220

The first postoperative visit, at the end of forty-eight hours, is important to both the patient and the dentist, who learns at this visit what the probable outcome of the operation will be.

In order to minimize or abort postoperative surface tissue infections or ulcerations of a mycotic nature, which may complicate intra-oral wounds following the removal of impacted teeth, jaw cysts or benign and malignant

tumors, the surface of the wound and adjacent tissue areas are swabbed by means of cotton applicators saturated with an 8 per cent zinc chloride solution. The entire mouth is then well irrigated with a hot saline solution. For further control of secondary infection due to the presence of mixed organisms, especially the anaerobic group, the wound area or, more efficiently, the entire mouth cavity is again subjected to a hydrogen peroxide bath. This is accomplished by the use of cotton balls, which are saturated with full strength hydrogen peroxide and applied to the exposed tissue surface. The resulting foam is repeatedly washed away with a hot saline solution, until a clean tissue surface is obtained. This zinc chloride-hydrogen peroxide method of treatment is of particular value in the presence of extensive postoperative tissue sloughing, such as may follow the use of the cautery in the removal of benign and malignant tumors within the oral cavity. Its value will also be appreciated during the early postoperative healing of wounds following the removal of impacted teeth and those lesions previously associated with and treated for the Vincent's type of infection bearing the anaerobic group of organisms. Additional local medication and systemic chemotherapy depend on the associated symptoms.

One of the most troublesome postextraction symptoms, causing apprehension to the patient and inconvenience to the dentist, is persistent bleeding over a prolonged period of time. This bleeding may be osseous or capillary or may be due to severing of an accessory and small branch of the lingual or buccal vessel, not dangerous, but alarming to the patient and his relatives. Instruction for home control of this type of hemorrhage may avoid a midnight telephone call. Preoperative questioning of the patient for a history of past hemorrhages may often anticipate the situation with proper precautions. Senile, diabetic, anemic and hypertensive patients may require preparation for hastening blood clotting and reducing bleeding time, as a preoperative precaution. This atypical postoperative hemorrhage may persist in spite of a laboratory report of blood clotting and bleeding time within normal limits. The more serious type of atypical bleeding and the hemophilic case require hospitalization for any type of surgical procedure. For the common type of bleeding, local suturing or vessel ligation plus the use of gauze packs saturated with such styptic solutions as thromboplastin and hemostatic globulin, in addition to various iron solutions, will solve the problem. Recent clinical research in the use of fibrin foam with thrombin, and absorbable gelatin sponge and thrombin, for hemorrhage holds great promise for application in oral surgery. Systemically, intravenous, intramuscular or hypodermic injection of calcium lactate, thromboplastin, vitamin K or snake venom and finally blood infusion or transfusion may be utilized. The patient's own blood, 50 cc. in divided doses, may be used as a foreign protein substance to assist in blood coagulation. Any of these methods will depend on the judgment of the operator.

The dentist is today taking advantage of medical progress and is resorting to more systemic therapy to assist him in securing better surgical results. Symptoms of avitaminosis related to oral diseases are being controlled and prevented by vitamin medication. Addition of cevitamic or ascorbic acid, rivoflavin and thiamin chloride alone or in combination to a properly balanced diet has been found of therapeutic value in the treatment of many oral diseases. Vitamins should only be prescribed after diagnosis and in sufficient therapeutic doses to assure the desired results. The cooperation of an internist may be necessary.

After the introduction of vitamin therapy, the sulfonamides attained a phenomenal status in chemotherapy. Sulfanilamide, sulfathiazole and sulfadiazine were followed in rapid order by additional groups of the sulfonamides, which have been used topically and systemically to advantage in many oral diseases. The special pharmacologic action of the sulfa drugs depends on their solubility and on a satisfactory concentration of the free drug in the body. The sensitivity of the organism and the blood concentration are guides to the therapy level. The blood picture, in addition to other systemic symptoms, should be observed closely, while organic damage to the liver and kidneys should be considered as among sources of toxic conditions in the human body. It is important that the organism contributing to the disease be determined by smear, culture or otherwise, so that the sulfonamide acting against the prevalent organism can be determined. For successful sulfonamide therapy, hospitalization may be essential.

Sulfonamides have been utilized for local application in oral therapy with a variety of results. Application of sulfanilamide and sulfathiazole, in powder or crystal form and in a miscible base, is believed to have some beneficial clinical results in infections about the jaws. More detailed records are necessary. The accumulated war experience in the local use of sulfonamides in wound management does not justify its employment. Therefore, its local use has been discontinued.

With the advent of penicillin, the treatment of oral infections has entered a new phase, with startling results in some instances. In the treatment of acute conditions about the jaws, optimism has reached a new level. Penicillin therapy, like the sulfonamide treatment, depends on the sensitivity of the organism and on continued concentration of the drug in the body for beneficial results. To date, the parenteral introduction of this drug is the method of choice. More recently, oral and local application have been utilized with some good effects. Tabulated results of the method of choice remain for the future.

Dentistry has kept stride with surgery and chemotherapy as related to surgical care. These advances have been due to the alertness of dental teachers and the persistent study of dental students.

64 Hamilton Street.

COMPOUND COMPOSITE ODONTOME OF THE MANDIBLE

C. W. Waldron, M.D., D.D.S., Ralph G. Peterson, D.D.S., and H. G. Worman, D.D.S., Minneapolis, Minn.

Extensive composite odontomes present considerable operative difficulties in removal, which may be time consuming. Preservation of the normal bone surrounding the tumor may be impossible, and operative pathologic fracture may occur during the effort to remove densely calcified portions of the tumor, as evidenced in the case to be reported, which was further complicated by the accidental removal of the condyle head and neck, together with its base, in the upper portion of the ramus.

REPORT OF CASE

History.—A girl, aged 12, seen in August 1933, because of a prominence of the right cheek due to enlargement of the lower jaw, had no significant complaints other than a feeling of pressure and discomfort in the jaw in the molar region and ramus in the region of the enlargement. There was a history of extraction of one or two molar teeth in October 1931, after which the patient had complained of aching pains in the region. A lumpy enlargement was noted, but the increase in size of the jaw had become marked during the previous year. The occlusion of the teeth had become altered by the increase in size of the tumor.

Examination.—There was a definite enlargement of the right side of the face in the molar region and the angle and ramus of the mandible, demonstrated, on palpation, to be due to the enlargement of the jaw. Intra-oral examination revealed a marked widening and elevation of the edentulous molar region. The mass extended upward well in front of the normal anterior margin of the ramus and coronoid process. The surface of the growth was somewhat irregular and hard on palpation and the overlying mucous membrane was normal in appearance. There was a shifting of the jaw to the right, apparently a voluntary effort to avoid pressure of the growth upon the upper teeth on closing the mouth.

X-ray examination (Figs. 1 and 2) revealed that the tumor was a compound composite odontome. There was marked destruction of the body and ramus of the mandible. The only normal-appearing bone distally from the bicuspid teeth was that in the lower border in the molar region, the posterior border of the ramus and the condylar and coronoid process. In the region of the angle, the entire continuity of height of the jaw appeared to be destroyed. The postero-anterior x-ray film confirmed the size and width of the tumor, the complete loss of normal bone in the region of the angle and the deviation to the right.

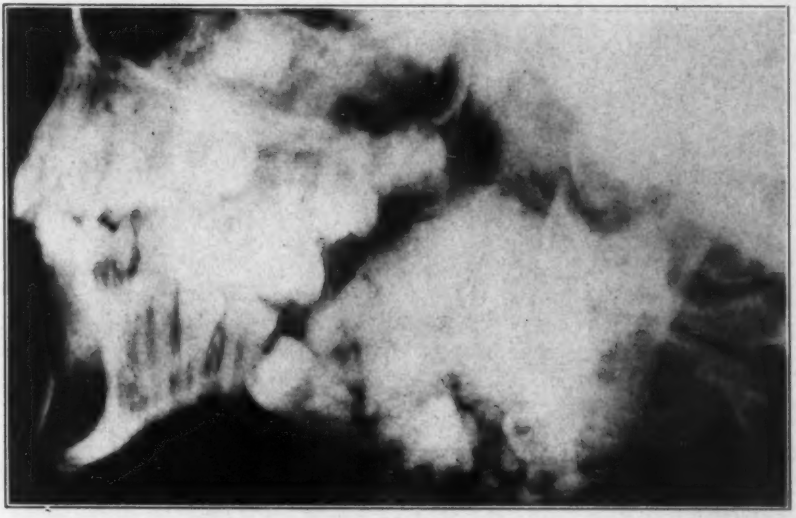

Fig. 1.—Preoperative x-ray view, right side of mandible, showing compound composite odontome with extensive destruction of mandible.

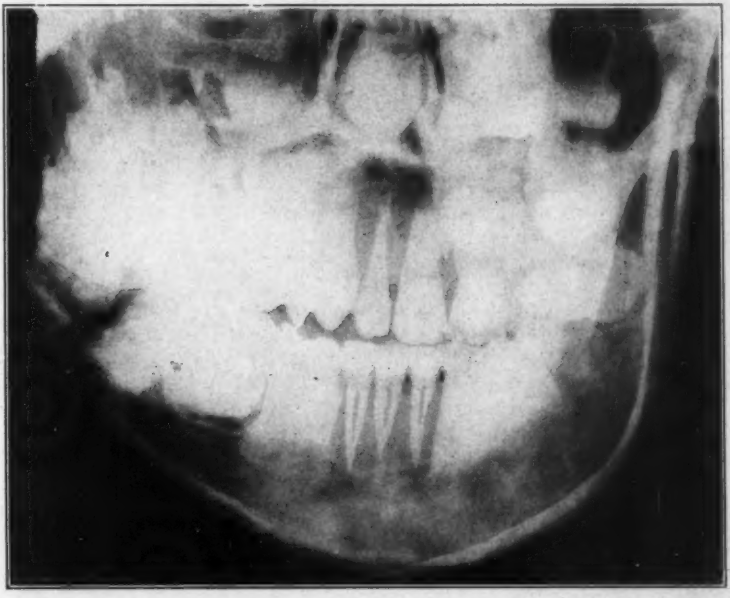

Fig. 2.—Postero-anterior x-ray film of tumor which confirms complete destruction of mandible in region of angle.

Fig. 3.—Lateral jaw x-ray film showing amount of tumor removed at first operation.

Fig. 4.—Left: Gross specimens removed at first operation. Right: Remaining tumor, removed at second operation. The condyle head, neck and base were removed at the second operation.

There were no significant findings with reference to the general physical condition.

Operation.—August 30, 1933, under nitrous oxide-oxygen anesthesia, an incision was made intra-orally along the prominence of the tumor from the midportion of the coronoid region to the bicuspid region. Here, it was continued lingually in front of the tumor and diagonally forward on the buccal aspect. The mucoperiosteum was elevated and retracted buccally and lingually to expose the tumor mass, which was found to be densely calcified with no evidence of thinned-out alveolar process on its exposed surface. An attempt was made to determine whether there was a line of cleavage between the tumor and the mandibular bone in the molar region. None was found, the tumor being apparently fused with the bone. It was obvious that it could not be removed from the jaw except by piecemeal excision using drills, chisels and

elevators. This was a tedious, painstaking procedure, the presence of the embedded and fused teeth adding to the difficulty of dividing and removing portions of the densely calcified mass. After one hour, but half of the tumor mass had been removed and the patient's color and general condition indicated that it would be hazardous to continue with the operation.

Postoperative Course.—An iodoform gauze packing was inserted in the cavity in the mandible. There was mild shock, due to the amount of bleeding and the length of the operation and the anesthesia. The condition of shock was treated and recovery was prompt, the patient being discharged from the hospital the day after the incomplete removal of the odontome.

She returned to the clinic twice a week for change of the intra-oral dressing and was again admitted to the hospital November 8, 1933, for excision of the remaining posterior portion of the tumor.

Fig. 5.—Lateral jaw x-ray film, showing union of pathologic fracture with some shortening and forward displacement of posterior fragment.

Examination showed that the area previously operated on was incompletely healed to the surface with a sinus posteriorly leading to the surface of the tumor. (Fig. 3.)

General physical examination showed that the patient was well developed and well nourished, with no abnormal conditions. Blood examination revealed a mild degree of anemia.

Second Operation.—November 11, 1933, under ether intrapharyngeal insufflation anesthesia, the coronoid and retromolar area was incised throughout its length and the tumor exposed. The same painstaking method of drilling, chiseling and prying out the dense calcified tumor was used as in the first procedure. As was anticipated, the complete vertical loss of bone at the region of the angle resulted in a pathologic operative fracture, which made removal of

the remaining tumor of the ramus much more time consuming as the posterior fragment became mobile and difficult to hold. During the attempt to remove the last remaining portion of the tumor from the region of the base of the condylar process, the entire condyle was pulled out of its periosteum and into the oral cavity by a too strenuous effort to pull it into view and steady it for drilling and chiseling. (Fig. 4.) The wound was packed with a lubricated iodoform gauze packing. Units of loop wiring were attached to the upper and

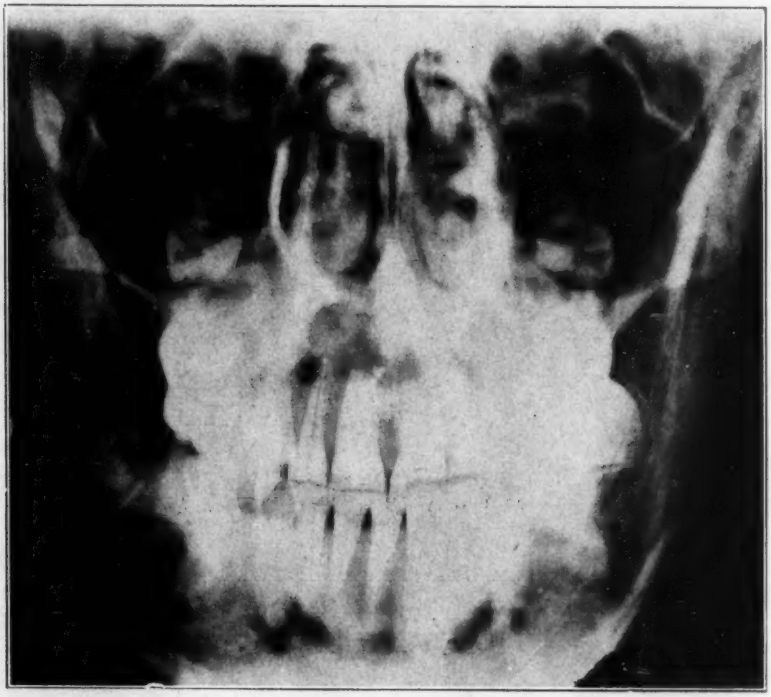

Fig. 6.—Postero-anterior view, March 19, 1935, sixteen months after operation, showing excellent regeneration of mandible at site of odontome.

lower teeth to permit intermaxillary fixation by the wires as soon as the condition of the patient would permit. The operation required two hours and a half, but the patient returned to bed in good condition.

Course.—There were no postoperative complications and the teeth were wired in occlusion two days after the operation. The patient was discharged from the hospital November 15, the fourth day after operation.

Further regular observations and treatments were carried out in the clinic. The intra-oral dressings were changed every three or four days and were dis-

Fig. 7.—Lateral jaw x-ray film, March 19, 1935. There is regeneration of the condyle head and neck, with a small densely calcified area in the molar alveolar process, and apparently an increase in size of a small amount of tissue not completely removed from the process. (Compare Figs. 5, 8 and 9.)

Fig. 8.—Lateral view of jaw, February 10, 1937, four years after operation, showing some increase in calcific area.

Fig. 9.—Lateral view of jaw, May 13, 1944, ten and one-half years after operation, showing excellent regeneration of mandible with reestablishment of contour and configuration. The calcific area had apparently enlarged slightly over the past seven years.

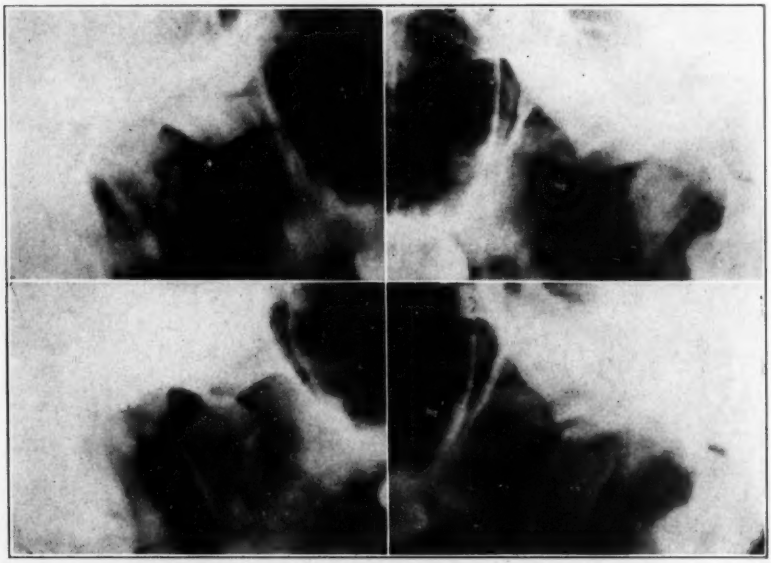

Fig. 10.—Temporomandibular joint studies showing complete regeneration of condyle head, with normal position in glenoid fossa and normal forward excursion on opening mouth. The regenerated condyle head (right) is more rounded and is not so large, nor does it show the forward inclination of the one on the unaffected side (left).

continued after five weeks. The tie wires were removed six weeks after operation and examination revealed unexpected stiffening of the ramus region and lack of the typical mobility of nonunion. On opening the mouth, there was deviation to the right. This was improved by manipulation and the temporary use of diagonal rubber bands.

X-ray examination, March 3, 1934 (Fig. 5), three and one-half months after operation, showed union of the fracture at the angle with some forward displacement of the ramus and complete regeneration of the head of the condyle, which appeared to be in a forward position on both clinical and x-ray examination.

The patient has been kept under periodic observation until the present time. Repeated x-ray examination showed further growth and development of the body and ramus of the jaw. (Figs. 6, 7, 8 and 9.) In 1937, it was found that a previously noted small calcified area, apparently not completely removed from the lingual portion of the process in the second molar region, had enlarged considerably. X-ray examination at yearly intervals revealed but slight additional growth. In 1944, this calcific growth was removed because of some discomfort in the area. Healing was uneventful. (Figs. 5, 7, 8 and 9.)

The patient (1945) presents virtually no deformity and the function of the lower jaw is practically normal. There is no evidence of fifth nerve anesthesia or paresthesia of the teeth and lip.

SUMMARY

The accidental extrusion of the condyle neck and head from its periosteal coverings was probably due to an uninfected inflammatory edema of the periosteum, which weakened its attachment. This had no doubt resulted from the spread of a low grade inflammation of the periosteum in the region of the angle after the first surgical procedure. The osteogenetic function of the periosteum was apparently undamaged, as evidenced by the degree of regeneration. X-ray studies of both temporomandibular joints (McQueen projection) (Fig. 10) taken May 11, 1938, show that the new head is somewhat more rounded and is shorter in its anterior-posterior horizontal diameter. Its movements are essentially normal and, in closed position, it appears to be less retruded than the condyle on the left side.

The wiring of the jaws in occlusion during the postoperative period of beginning regeneration must have been of service in counteracting the effects of pull of the external pterygoid muscle on the periosteal sac left by the accidental removal of the condyle. The apparently delayed backward repositioning of the regenerating condyle head is somewhat difficult to explain.

ERRATUM

We regret the omission of one of Dr. Henry B. Clark, Jr.'s degrees above his article, "Study of One Hundred Fifty Cases of Fracture of the Upper Jaw in an Overseas Maxillofacial Center," which appeared in the October issue of the JOURNAL OF ORAL SURGERY. The author's line should have read: Henry B. Clark, Jr., M.D., D.D.S. Our sincere apologies to Dr. Clark for this omission.

OSTEOGENIC SARCOMA OF THE MAXILLA: REPORT OF CASE

L. R. Boies, M.D.; R. G. Peterson, D.D.S.; C. W. Waldron, M.D., D.D.S., and K. W. Stenstrom, Ph.D., Minneapolis, Minn.

The osteogenic sarcoma is one of the most serious of the tumors involving bone and the prognosis is grave in that five-year cures occur in by far the minority of recorded cases. Approximately 10 per cent of the malignant tumors arising in or involving the maxillary sinus are of this type, and the insidious onset and varied symptomatology simulating dental or sinus disease usually results in considerable delay in instituting proper treatment. Osteogenic sarcomas may develop within the alveolar process of the maxilla or from the deeper layers of the periosteum on its buccal or palatal aspects. Such tumors are also relatively infrequent, and it is difficult to estimate what percentage of malignant tumors of the upper jaw are osteogenic.

It is obvious that, in order to save lives, the dentist, the oral surgeon, the rhinologist and the general surgeon, in their overlapping fields of endeavor, must recognize the need for increased cooperative effort in the search for the cause of obscure signs and symptoms in this region. The methods of treatment to be employed should be based on an understanding of the advances in the therapy of such highly malignant tumors. Skilful surgical operations and modern roentgen and radium therapy should be available and the method or combination of methods of choice in the individual case should be determined by consultation, with the best interest of the patient the only consideration.

No prejudices or lack of fully effective deep x-ray or radium facilities should reduce the possibility of a successful outcome in these cases, when prognosis at best is unfavorable. Rich or poor, such patients should have everything possible available for treatment according to the latest proven methods for the care of such conditions. Osteogenic sarcomas present such wide variations of sarcomatous cellular detail even in a single tumor that numerous names have been applied to these tumors according to the predominant cell of the section examined.

The possibility of coincidental tumors of different types must be kept in mind during the course of treatment of obscure type tumors, as was evidenced in the case to be reported. The first biopsy specimen was reported as sarcomatous. Rechecked tissue removed at two subsequent operative procedures failed to show malignancy; whereas, on final surgical exploration, the tissue removed was highly malignant.

REPORT OF CASE

History.—A girl, aged 12, admitted to the otology, rhinology and laryngology service of the University of Minnesota Hospital, April 9, 1944, for treatment

of a tumor involving the left side of the upper jaw and maxillary sinus, gave a history of enlargement of the jaw dating back but two or three months, at about the time she had suffered from a severe cold. There had been virtually no pain or bleeding from the mouth or nose and no toothache or loosening of the teeth on the affected side. The left nostril had become partially obstructed, though at times this symptom was less pronounced. The absence of the upper left cuspid tooth, together with evidence of loss of bone and misplaced unerupted teeth, as shown in the x-ray film, was suggestive of dentigerous cyst. The cuspid tooth had been removed. A biopsy resulted in a diagnosis of sarcoma. The patient was then sent to Minneapolis for treatment.

The personal and family history yielded nothing of importance. There was no history of injury.

Fig. 1.—Postero-anterior roentgenogram (Waters-Waldron sinus projection), showing the extensive involvement of the sinus area.

Examination.—A prominence of the left side of the cheek and upper lip was due to the underlying enlargement of the maxilla. The cuspid and bicuspid teeth were absent from the arch, and there was some palatal enlargement, with a slight labial prominence above the roots of the incisor teeth. Nasal examination revealed an elevation of the floor of the nose on the left side. X-ray films of the sinuses and maxilla showed extensive involvement. (Figs. 1 and 2.)

Complete physical examination, including all routine laboratory tests, revealed no significant departures from the normal.

Operation.—April 8, 1944, under intratracheal cyclopropane anesthesia, the region was explored (L.R.B.). A horizontal incision through the canine fossa, the usual approach to the maxillary sinus, allowed the escape of some thin fluid and resulted in considerable bleeding. Granulation tissue and a loose tooth were removed from the floor of the antrum. The bleeding, which was rather profuse, was controlled by packing. A large cystic sac found in the

upper portion of the antrum was completely removed. Frozen sections of the granulation tissue revealed chronic inflammation. All of the apparent tumor tissue was removed. The diagnosis was cyst of dental origin. The wound was packed with balsam of Peru gauze, which was brought out through a naso-antral window. The opening in the canine fossa was sutured. The patient returned to bed in good condition.

Microscopic examination of a number of sections of removed tissue failed to show sarcoma, but rather showed chronic inflammation and cyst wall formation.

Course.—There were no apparent postoperative complications and the patient was discharged on the sixth day after operation to return to the clinic for further care. About a week later, she developed symptoms of retention of exudate accompanied by fever, pain and malaise.

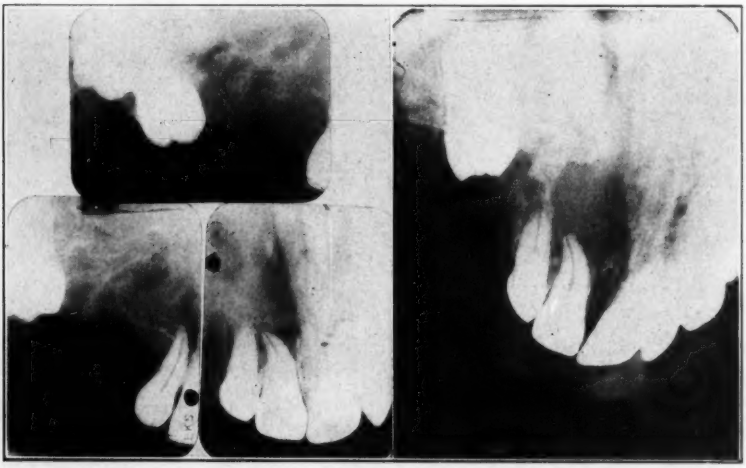

Fig. 2.—Routine dental and occlusal roentgenograms, showing the extensive destruction of the alvelolar process of the maxilla.

The patient was admitted to Abbott hospital, April 17, because there were no beds available at University Hospital. Sulfonamide therapy was instituted and the acute symptoms subsided. Eleven days later, under ether anesthesia (C.W.W., R.G.P.), the maxillary sinus area was again explored on the assumption that the hemorrhage encountered at the previous operation had prevented removal of the cyst wall at its anterior extension. New dental x-ray films seemed to show considerable loss of bone.

Second Operation.—Because of the previous diagnosis of a chronic inflammation of a cystic wall rather than malignancy, surgical measures were again conservative. The maxillary sinus was found partially filled with granulation tissue, which was removed. An attempt was made to remove any cyst wall or chronically infected tissue from above the incisors without extending the incision forward and thus removing the thinned-out labial plate of bone over these

teeth. By leaving this, it was hoped that this area would regenerate without loss of the teeth and that, subsequently, the antronasal window could be enlarged and the oral-antral incision fistula closed.

On completion of the operation, it was believed that adequate access to the area above the incisors had been obtained. This area and the maxillary sinus were then lightly packed with one-half inch iodoform gauze lubricated with acrithesin ointment. Again microscopic examination revealed chronic inflammation and no evidence of malignancy. There were no postoperative complications and, after two weeks' observation, the patient was allowed to leave Minneapolis and return home, subsequent dressings to be taken care of by her own physician.

Course.—Further difficulties of drainage developed and she returned, June

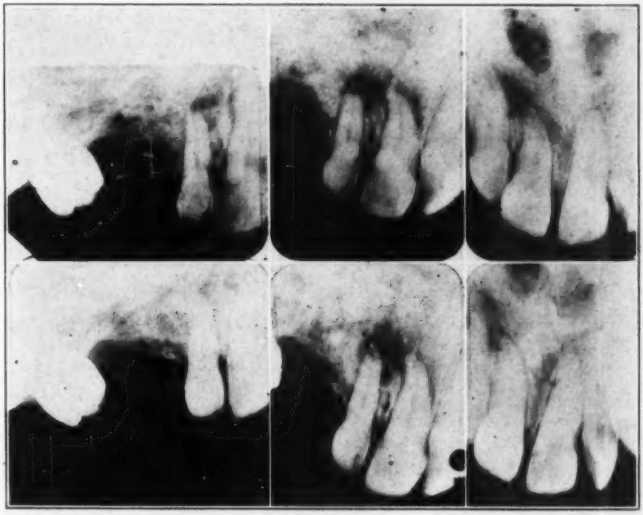

Fig. 3.—Upper: Roentgenograms taken seven months after roentgen therapy for osteogenic sarcoma of the maxilla, showing very considerable regeneration of the alveolar process. Lower: Roentgenograms taken eleven months after roentgen therapy, showing further increase in bone formation. The incisors and molar teeth were quite tight in the alveolar process.

20, 1945. Examination revealed an increased prominence over the labial alveolar process and new dental x-ray films seemed to indicate an increase in size of the affected area. The incisors had become quite loose. It was then decided to explore the area on the labial aspect above the root end level of the incisor teeth. This was done under procaine anesthesia (R.G.P.). The labial plate was extremely thin and absent in certain areas. It was apparent that the lesion was not cystic, but rather a tumor of fleshy consistency. In view of the first biopsy diagnosis, it was deemed unwise to do any more than remove a liberal amount of tumor tissue for examination. This tissue proved to be osteogenic sarcoma with marked cellular activity.

Chest x-ray films were negative for metastasis.

It was obvious that any attempt to remove the tumor surgically might necessitate total excision of the left side of the maxilla and the nasal structures, the exenteration of the left orbit and partial excision of the maxilla and nasal structures on the right side. No less hazardous or mutilating were diathermy excision and coagulation.

Further consultation with the pathologists, surgeons of the tumor clinic and director of the x-ray therapy department led to a decision to try roentgen therapy.

Treatment.—The treatment extended from June 26 to July 24 inclusive, as follows: 220 KVP; 1 mm. copper + 1 mm. aluminum filter; half value layer, 1.7 mm. copper; 60 cm., target skin distance; a total dose of 2,100 r (air) to each of one anterior and one lateral 6 by 7 cm. field to the left maxillary region in eighteen treatments over twenty-nine days with an addition of 500 r through an oral cone to the left side of the roof of mouth.

There were marked local and systemic reactions to the roentgen therapy. July 12, after eleven x-ray treatments, it was apparent that the prominences of the tumor were becoming less on the buccal and palatal aspects and in the floor of the nose.

Further consultations were secured and a decision was made to continue x-ray therapy. The tumor continued to subside. The oral-antral-buccal fistula was dressed twice weekly with acrithesin gauze. The patient returned home, to be seen there by her physician for change of dressings.

Outcome.—In September, she returned for examination, at which time all tumor prominences had returned to normal levels and contours. Her health had improved.

Further examination was made October 28, 1944. The buccal fistula had healed and the incisor and molar teeth were but slightly loose.

February 10, 1945, examination was negative except for the loss of the left cuspid and bicuspid teeth. The left incisors did not respond to vitality tests though dental x-ray examination showed that regeneration of bone around and above the incisor roots was taking place. The patient felt well and appeared healthy. When seen in December, 1945, she had grown 2 or 3 inches in height and had gained in weight and strength. Local and systemic examinations were negative for any abnormalities. New x-ray pictures of the upper jaw showed increase in bone formation and the incisors and molar teeth were firm.

SUMMARY

1. An unusual case of a cystic tumor showed chronic inflammation involving the maxillary sinus in association with a highly malignant osteogenic sarcoma of the maxilla.

2. Months of survival and normal health and development after deep x-ray therapy, together with evidence of bone regeneration of the maxilla, lend hope that the case may continue free from recurrence.

3. The necessity of frequent revaluation of clinical findings and repeated microscopic examinations in obscure cases of tumor formation and inflammation in the oral region is apparent.

SURGICAL TREATMENT OF MANDIBULAR PROGNATHISM

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The surgical correction of mandibular prognathism, once a relatively rare operation, has become a commonplace procedure. An increasing number of published case reports indicates the interest of surgeons in these severe class III deformities that are not amenable to orthodontic treatment. The results, by and large, of surgery for this condition have been most gratifying, and we know of no class of patients that is as grateful for the services rendered. The striking improvement in facial appearance and the restoration of the function of mastication are almost spectacular. In most cases, the mental attitude of the patients is so markedly changed and their social and business relationships are so broadened with the elimination of an inferiority complex that a new interest in life is manifested. Numerous reports from patients and their friends have stressed the point that the surgical correction was a milestone in their social and business careers.

A survey of the literature on the subject reveals a variety of technics employed with more or less uniformly good results. Personal conversations with a number of surgeons indicate that a frank discussion of the fundamentals and problems of this type of surgery would be of service. This is the object of the present communication, which is based on our experiences in some fifty cases. We hope that it will stimulate further discussion and detailed reports adding to the sum total of information on the subject. It is not our purpose to discuss the somewhat obscure and complex etiology of the deformity, but rather to present from every possible angle our approach to and our concepts of the problems that confront us.

DIAGNOSIS

The patient's record should include a brief medical history with notations as to the presence of similar deformities in the parents or other members of the immediate family. An effort should be made to determine when the deformity first became apparent and the rate of increase of the protrusion. A history of nasopharyngeal (adenoid) obstruction and particularly the presence of marked chronic tonsillar swelling and throat obstruction in childhood is of interest, for combined postnasal and throat obstruction may result in chronic voluntary protrusion of the lower jaw to secure an adequate airway. The patient's general physical condition should be appraised as a preoperative routine. Any abnormal enlargement of the tongue should be noted.

Special examinations should include photographic records: full face, right and left profile and a close-up view of the teeth in malocclusion. Profile x-ray examination at 5 feet will usually show the approximate true anatomic dimensions of bony structures and both bony and soft tissue profiles. In taking photographs and roentgenograms, it is essential that the teeth be tightly closed in order to obtain accurate records. Lateral jaw roentgenograms to show the rami and condyles unobscured by the superimposition of the spine are of service and are particularly necessary for patients with deviation deformity.

An osteoma of the condyle will produce an identical occlusal and prognathic deformity and should be ruled out. If the lateral jaw projections do not clearly show the condyle head relationships, additional temporomandibular joint roentgenograms should be taken. These, we feel, are particularly necessary in cases where prolonged orthodontic treatment has been ineffectual in correcting the prognathism. We have noted marked posterior displacement of the condyle heads in a number of these cases.

Dental examinations should be complete and should in most instances include a full mouth roentgenogram. Facial moulages, or casts, may be of interest. We formerly made them in most cases but now reserve them for very unusual conditions. Duplicate impressions and casts of upper and lower teeth with bite recordings are essential and in many cases three sets are of service. By matching the lower cast with the upper cast, a preliminary estimation of the occlusal relationship after surgical replacement is usually possible. It can then be determined whether orthodontic treatment of the upper or lower teeth or of both arches is indicated before or after surgical repositioning. Careful study of the casts may indicate whether excising sections of the body of the mandible or osteotomy of the rami is the operation of choice. This will be discussed at length later.

It is our opinion that some type of graphic diagnostic treatment chart which could be used by surgeons doing this type of work would be of considerable interest and probably of great service in the statistical study of the problems of treatment. We are preparing a chart on which will be recorded the types of prognathism, as suggested by Landais (as quoted by Hensel[1]):

A. *Mandibular Prognathism:*

1. Molar contact and incisive supraclusion.
2. Molar contact and incisive infraclusion.
3. Molar infraclusion and incisive supraclusion.
4. Generalized infraclusion.
5. Generalized supraclusion.

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1. Hensel, G. C.: Surgical Correction of Mandibular Protraction, Retraction, and Fractures of the Ascending Rami. Internat. J. Orthodontia & Oral Surg. 23:814, August 1937.

B. *Obtuse Mandible Without Prognathism:*
Molar contact and generalized infraclusion otherwise.
C. *Mandibular Laterognathism:*
1. With molar infraclusion and incisive supraclusion.
2. With molar contact and incisive infraclusion.

Other records include the description of the rami, whether normal, short or long, and their angle, whether acute or obtuse; the height of the symphysis, whether normal, short or excessive; the temporomandibular joint relationships; an estimation of the development of the maxilla and its position, normal or retracted; if retracted, measurement of the actual and relative prognathism; measurement of the lateral deviation of the mandible; loss of posterior teeth on the mandible or maxilla; edentulous mandible or maxilla; previous orthodontic treatment, duration in years; measurement of setback, right and left, or amount of bone excised in operations upon the body of the jaw; direct surgical wiring of the fragments, right and left; method of interdental fixation or control, whether secure, fairly secure or moderately well controlled; time of interdental fixation in days; necessity of further immobilization by tie wires or rubber traction; results. It is probable that further items might be added to such a graphic record that would improve it.

The upper cast is mounted on a special articulator using a face bow to establish a reasonably accurate relationship with the position of the condyle heads of the articulator. In addition, the occlusal relationship of the teeth of the upper cast should conform with the horizontal of the Frankfort plane which is a horizontal line drawn from the orbitalia to the superior border of the tragus. The articulator is mounted on a table stand, the upper cast being stationary and the lower cast mounting moving by means of a ball and socket joint from the established temporomandibular joint region of the articulator. We have listened to lengthy explanations that the conventional dental articulator, with the upper cast capable of motion, is based on the identical mechanical principle, but our surgical minds seem incapable of visualizing or interpreting this reverse action. We therefore decided to construct and experiment with an articulator providing movement of the lower portion carrying the cast of the lower teeth. (Fig. 1.) The cast of the upper teeth is mounted securely in reasonably normal relationship with the joints of the articulator and the horizontal plane. We have found this articulator of considerable service to us in our preoperative study of the surgical problems. For several years, we have wanted to improve as well as simplify it, but pressure of work has prevented our doing so. We have, however, had the satisfaction of determining preoperatively in a number of cases of deviation and moderate prognathism that the deformity could be entirely corrected by osteotomy of the ramus on one side only—with but slight rotation of the condyle head on the side toward which the jaw had

deviated. In this type of case, the articulator is particularly useful, for the lower portion with the lower cast may be swung and rotated on one joint only. In the majority of cases, the lower half of the articulator is not necessary for the preoperative study of the surgical problem. The lower cast may be articulated with the upper cast by means of the bite recording and numerous vertical and diagonal markings made to establish the preoperative relationship. A horizontal line parallel with the Frankfort plane and the

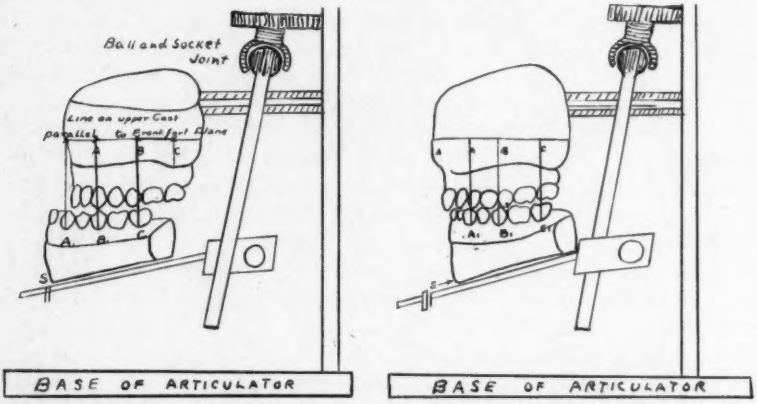

Fig. 1.—Diagrammatic plan of the articulator we are using for preoperative study of the procedure to be carried out. Measurements in the vertical plane from A to A1, B to B1, C to C1, are checked on the repositioned cast to determine the elevation or depression of the anterior or posterior teeth indicated to obtain the best possible occlusion. By these determinations, an estimate may be made of the necessity of a diagonal section of the ramus rather than section through the horizontal plane.

articulator base is made on the anterior and lateral portions of the upper cast mounting. The lower cast may then be placed on the base of the mandibular part of the articulator, or the cast may be held up in position by means of small boxes or plaster bases. By manipulating the lower cast, the amount of setback desired is determined and recorded. In cases presenting appreciable deviation as well as prognathism, measurements of the setback of the posterior teeth on either side in the reassembled midline occlusal position will determine the amount of posterior override of the ramus fragment on each side, or the amount of body excision when this is the procedure of choice. Vertical displacements such as open or closed bite and bicuspid or molar infraocclusion may be studied and evaluated in terms of diagonal (off horizontal) sectioning of the ramus, or "Y" or keystone excisions of the body of the mandible. Preoperative determination of cusp and occlusal interference and indicated grinding will facilitate the immediate postoperative wiring of the teeth in their new occlusion and make for better immobilization

and union of the surgical fractures. The duplicate casts of the teeth are of great service in determining the sites and the amount of occlusal grinding, since the interfering cusps, etc., can be removed on the casts and the casts used as a guide for preoperative grinding in the mouth. The casts are also used for determining the best method of wiring or types of appliances for complete immobilization of the teeth in occlusion. It is our opinion that reliance should not be placed on simple conventional methods of wiring for the eight weeks of immobilization. A securely applied Risdon twisted external arch wiring is, however, usually sufficiently stable, as is an external arch bar with lugs or hooks if securely wired to the teeth. Special considerations will indicate the necessity of cast splints, conventional or sectional with extensions or removable and adjustable attachments. The extensive splint experience of World War II has supplied a sufficient number of splint modifications to meet any unusual problem of immobilization. It cannot be too greatly emphasized that every precaution should be taken to ensure that the appliances are strong and secure and capable of functioning efficiently as long as necessary. An adequate number of tie wires, usually six or eight, is indicated to secure the teeth in occlusion.

Careful study of the casts of the upper and lower teeth will usually determine the site of election for section of the mandible. In the majority of cases in our experience, the reassembled casts occlude so well with minimal grinding that one would hardly suspect that they are of a prognathic case of one-half inch or more of protrusion. Examination of the cast in the repositioned desired occlusion shows in most instances that the posterior mandibular teeth, usually the second molars, are in vertical relation to the upper second molars, or not more than 2 or 3 mm. distal to them. In the majority of cases, there is no appreciable underdevelopment of the maxillary arch or overdevelopment of the mandibular arch. We, therefore, cannot see why in such cases any consideration should be given to the removal of a section of the body of the mandible in the bicuspid or molar region, which would obviously foreshorten the mandibular arch and occlusal surface and would not set back the angle of the jaw, which is usually obtuse and in a forward position. The setback secured by the osteotomy division of the rami effects a material improvement of facial contour at the angles.

In a small percentage of cases, there appears to be a markedly underdeveloped maxillary arch, sometimes in an apparent distal position associated with an overdeveloped mandible in prognathic position. Careful examination of the repositioned casts of such a case will immediately impress one with the fact that osteotomy of the rami is not feasible, for it would place one or two mandibular molars or a centimeter or more of alveolar process ridge in a position posterior to the tuberosities of the maxilla. It is obvious that a much better result may be anticipated by removing sections of the body of predetermined size and shape.

Fig. A—Case 8 (1939). Correction of actual and relative prognathism of the mandible in a cleft palate case. Left: Preoperative profile. Right: Postoperative profile. The mandible was set back approximately one-half inch.

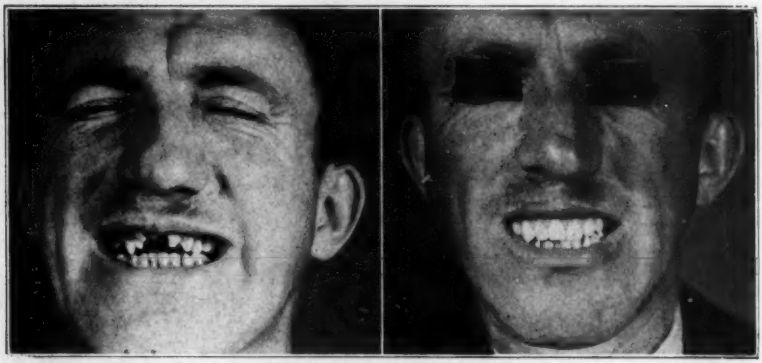

Fig. B—Case 8. Left: Postoperative occlusion: Right: Appearance with overdenture in place.

Worthy of intensive study is the problem of maxillary retrusion in association with mandibular prognathism which is more relative than real. Surgical experience warrants the consideration of operative division and forward repositioning of the maxilla in selected cases.

A considerable number of adult cleft palate patients, particularly of the bilateral cleft lip type repaired in infancy, present a great problem to the dentist and the plastic surgeon. The upper jaw may be not more than half its normal size, and the anterior teeth are situated a centimeter or more distal to their normal position. There is no effective occlusion, and during childhood the occlusal planes seem to have activated a forward thrust of

Fig. 2.—Case 1, aged 24 (1928). Prognathism deformity, mandibular molar regions edentulous; presenting an abnormal length of alveolar process ridges. See Figures 4 and 5. Correction was made by the removal of bone in the bicuspid molar regions of the right side. The nerve to the lip was preserved by exposure of the mental foramen and removal of bone to permit its exit in a position about a centimeter farther back. On the left side, on account of the presence of a second bicuspid tooth, the section of bone removed was farther distal and no attempt was made to preserve the nerve to the lip. Lip sensation recovered slowly on the left side but finally sensation on both sides and sensation of the anterior teeth became normal. Left: Preoperative photograph. Right: Postoperative photograph.

the mandible to produce an actual prognathism of a centimeter or more as determined by profile studies of forehead, nose and chin relationships. There then results a prognathism of 2 cm. or more, combined relative and actual. The upper lip is markedly depressed, facial deformity is pronounced and the patients find great difficulty in adjusting themselves to their social and occupational environment. No acceptable dental appearance can be secured other than by a denture fitted over the remaining teeth to support the upper lip and make possible an acceptable appearance on speaking and smiling. This can be accomplished in some cases of this type if the actual mandibular prognathism is very slight. In most cases, however, the upper teeth of the new denture must be set so far forward, even to reach a position of lingual contact with the mandibular incisors, that the excessive forward projection and consequent leverage make a satisfactory denture technically impossible. We decided to set the mandible back a distance that corresponded with what we considered the actual prognathism, or a little more, with the idea that the prosthetic specialist could then construct the overdenture without undue forward projection and leverage. (Figs. A and B.) This we have done in six cases, with better results than we anticipated. In some of the cases, cosmetic nasal plastic and lip surgery, together with the

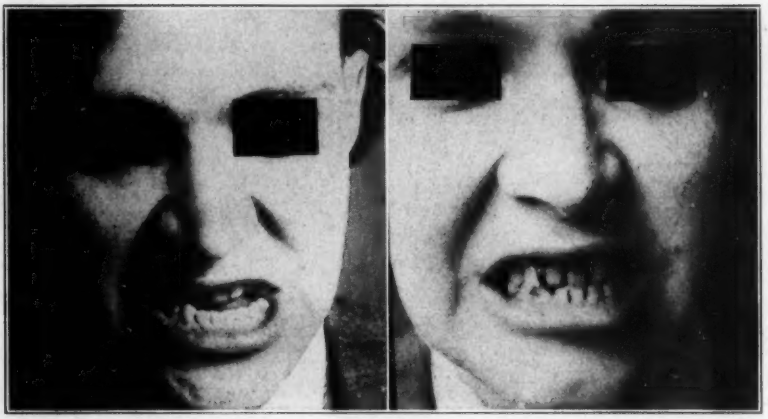

Fig. 3.—Case 1. Left: Preoperative prognathism, malocclusion. Right: Postoperative occlusion.

bilateral osteotomy and the overdenture, completely changed the patients' outlook on life and subsequent activities. (Figs. A and B.)

Our early experiences were limited to excision of sections of bone in the body of the mandible. Both bilateral and unilateral operations were performed, with subsequent bony union and definite improvement in appearance and function. The surgical approach was submandibular and the bony fragments were wired in apposition with silver wire.

Case 1 illustrates this type of approach. (Figs. 2-7.) Case 2 was slightly

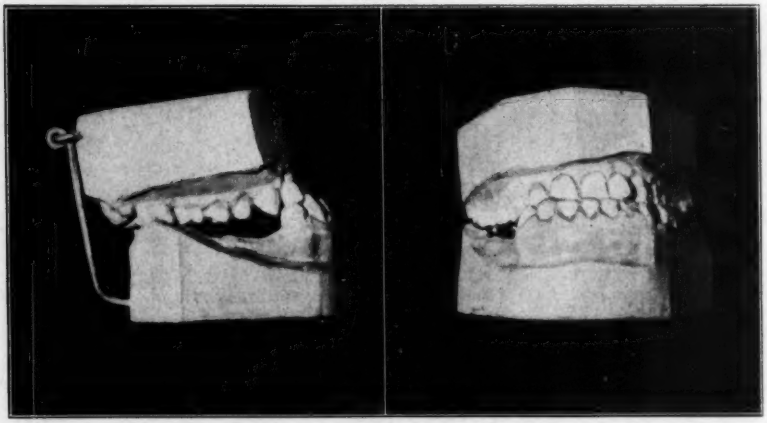

Fig. 4.—Case 1. Casts, showing preoperative prognathism.

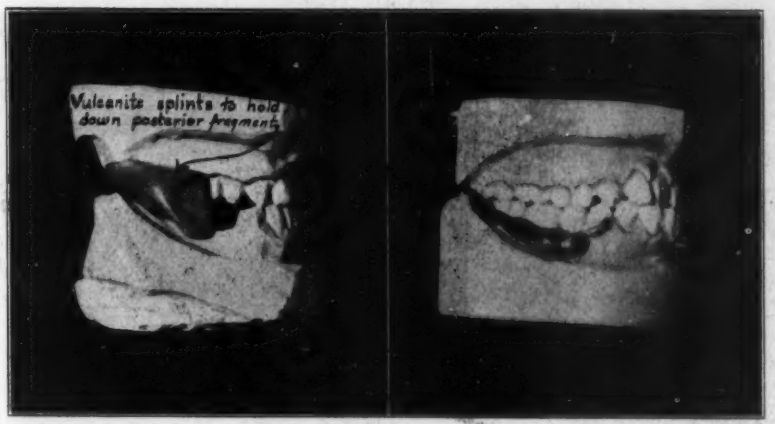

Fig. 5.—Case 1. Left: Cast, showing the vulcanite occlusal splint to maintain alveolar process fragment after excision and surgical wiring. Right: Cast showing the partial denture restoration.

Fig. 6.—Case 1. Preoperative lateral jaw x-ray films, right and left, showing the prognathism deformity and the extreme length of the alveolar process ridges.

Fig. 7.—Case 1. Postoperative lateral jaw x-ray films taken one year after operation, showing complete bony union of the regions of the excisions.

prognathic with marked unilateral deviation, both corrected by the removal of a section of bone on one side only. The bone was divided and removed with burs, chisels and bone-biting forceps. The mandibular nerve in the canal was dissected free and preserved in some instances and divided in others without any appreciable difference in the ultimate results. (Figs. 8-11.)

Subsequently, cases presented where examination of the casts of the teeth indicated that the occlusion would be better established without foreshortening the occlusal arch of the mandible by resection of bone in the body of the jaw (Case 3). (Figs. 12-18.) Diagonal osteotomy with resection of a previously estimated amount of bone just above the angle of the mandible was performed in a number of cases. The bone fragments were wired in

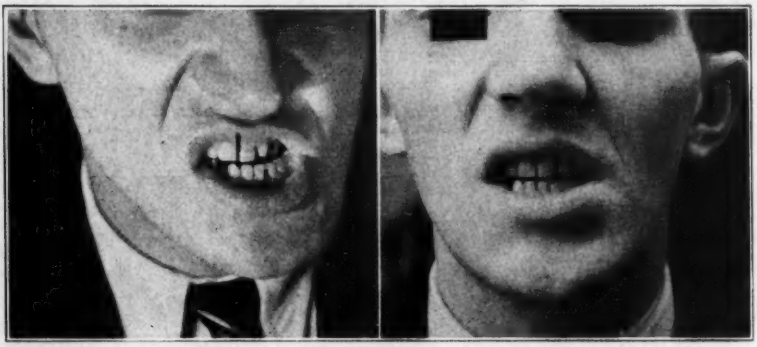

Fig. 8.—Case 2, aged 20 (1930). Left: Preoperative deviation, prognathism, malocclusion. Right: Postoperative occlusion before adjustment by occlusal grinding.

contact, in some instances with slight or moderate overriding. It is probable that not enough bone was removed in two of our cases in which operation was done by this method. The exact amount of bone to be removed in a diagonal plane is obviously difficult to estimate, and the procedure is difficult to execute. It is likewise hard to determine the exact amount of override if this type of apposition of fragments is used. An override of the posterior fragment tends to produce an undue prominence of the angle of the jaw. If insufficient bone is removed, wiring the teeth in the desired occlusion will force the posterior fragment back a variable distance. After bony union has taken place and the tie wires have been removed, the displacement may seem to produce an end-to-end bite or a slightly prognathic relationship. This is apparently due to the condyle and ramus moving forward to assume their preoperative position. We have, therefore, given up this site of operation. Our preference is the osteotomy of the ramus as the site of election for surgery when there are no specific indications for a foreshortening of

Fig. 9.—Case 2. Left: Maxillary cast metal open occlusion splint with labial hooks. Center: Cemented splints wired in correct occlusion at conclusion of operation. Right: Mandibular cast metal open occlusion splint.

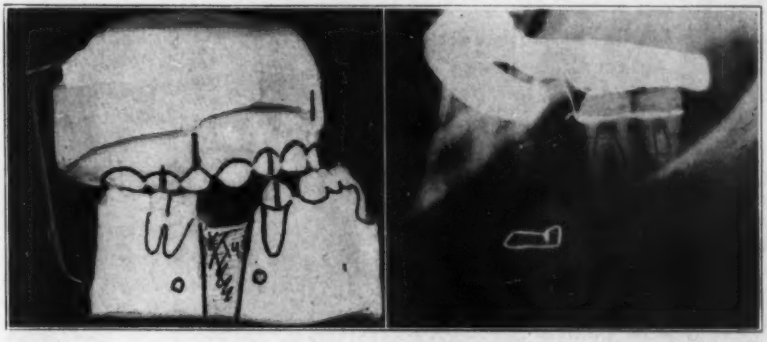

Fig. 10.—Case 2. Left: Cast, showing the position of section of bone removed to correct deformity. Right: Lateral jaw roentgenogram, showing region of operation and surgical wiring.

Fig. 11.—Case 2. Left: Full-face photograph, showing complete correction of deviation deformity. Right: Profile photograph, showing correction of prognathism.

the body of the jaw. It is generally considered wise to limit the slide-back of the lower margin of the osteotomy division to not more than two-thirds of the width of the horizontal diameter of the ramus at the level of the division, on account of the risk of nonunion or malunion with open bite displacement. This is particularly important when an open view operative procedure with surgical wiring is not undertaken.

In Case 4, the jaw was set back by extracting both third molar teeth, removing the buccal and lingual alveolar process and completely sectioning the body of the mandible. (Figs. 19, 20.) Infection was anticipated on account of compounding into the mouth, but it was felt that, with drainage, the result would measure up to the experiences with bilateral fractures involving third molars. The postoperative course would have been uncomplicated except for the fact that a small piece of Penrose drain split off and remained in the region of the osteotomy excision without being recognized. A sinus and moderate swelling persisted for several weeks until the area was explored and the foreign body removed. Prompt healing ensued, and the bony union was apparently not delayed. The prognathism was completely corrected and an effective occlusion established. This method, employed before the use of sulfonamide or penicillin therapy, should certainly have a place in the surgery of prognathism, now that protection by the administration of penicillin is possible. Extensive contemporary experience in bone surgery in military hospitals justifies this conclusion. This method should be reserved for those cases where the mandibular occlusal arch is very large and a ramus osteotomy setback would consequently place the mandibular second and third molar teeth distal to the tuberosities of the maxilla. We feel that the third molar, retromolar site of excision is much better than excision in the bicuspid-molar region, particularly when there is a full complement of teeth in the lower jaw. The occlusal arch form is neither disturbed nor deformed in any particular.

One patient with acromegaly, for whom a pituitary tumor had been removed several years previously, was operated on for prognathism in 1938. Bilateral excisions of approximately one-half inch of the body of the mandible were removed from the molar regions. The mandible was immobilized for seventy-eight days, when examination revealed that bony union was not complete. Rubber band immobilization was substituted for the tie wires for an additional period of two months. Union was still incomplete but progressed to complete consolidation without displacement.

It is obvious, as has been stated, that the case must be thoroughly studied and definite plans made for the operation of choice, for the immobilization of the mandible and for the construction of appliances or splints before surgery to ensure immobilization. Specific indications and problems vary considerably. Some patients have almost a full complement of teeth; others have but few remaining teeth and find themselves confronted with

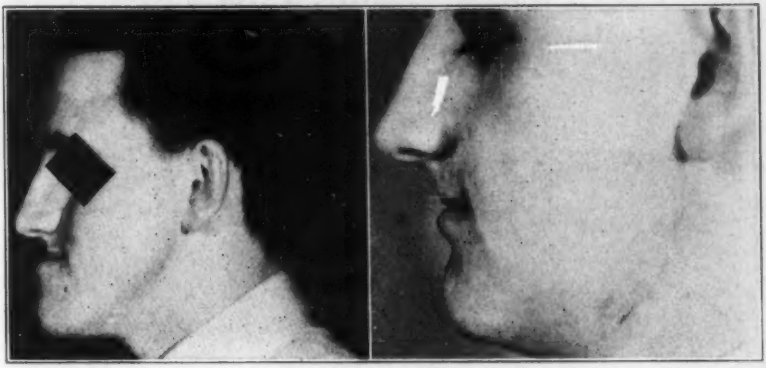

Fig. 12.—Case 3, aged 19 (1935). Marked prognathic deviation corrected by removal of a diagonal section of bone just above the angle of the mandible. Left: Photograph of profile before operation. Right: Photograph of profile after operation.

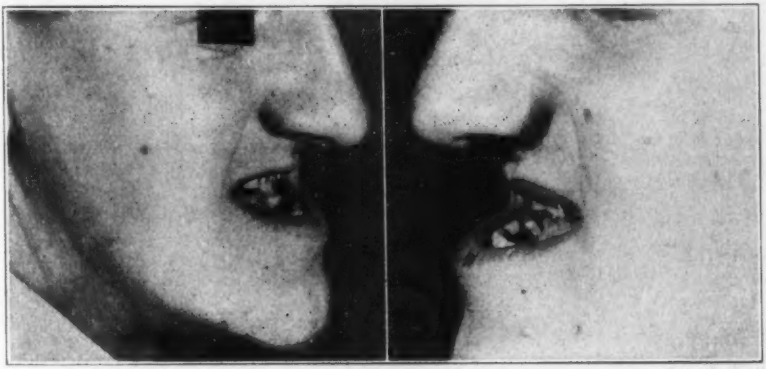

Fig. 13.—Case 3. Open bite malocclusion as seen from right and left sides.

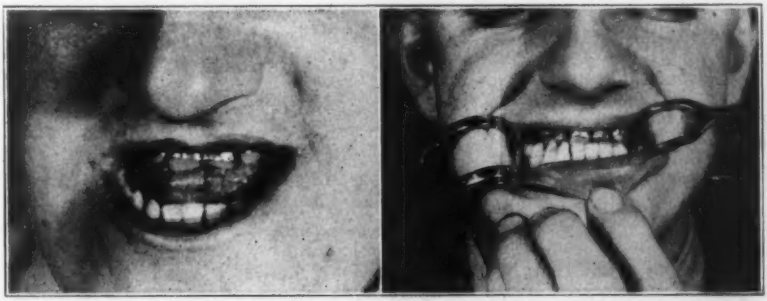

Fig. 14.—Case 3. Left: Preoperative open bite malocclusion. Right: Occlusion four months after operation.

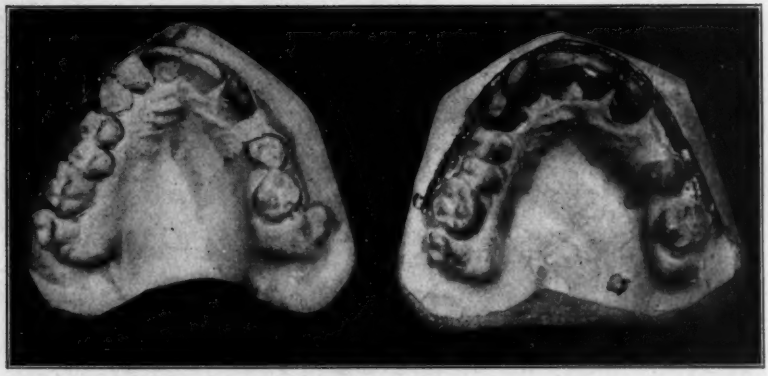

Fig. 15.—Case 3. Cast, showing expansion of upper arch by orthodontic treatment preliminary to surgery.

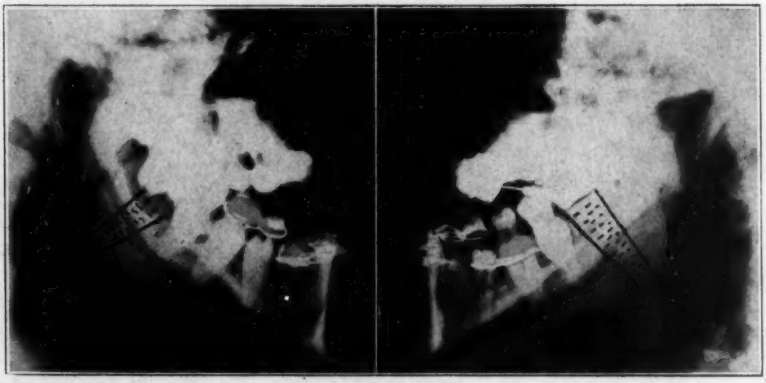

Fig. 16.—Case 3. Left: Lateral jaw roentgenogram of right side of mandible, showing molar contact and incisive infra-occlusion. Right: Lateral jaw roentgenogram of left side.

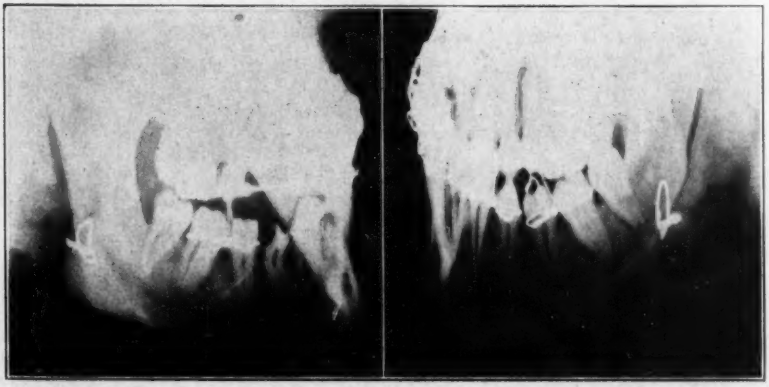

Fig. 17.—Case 3. Left: Postoperative lateral jaw roentgenogram of left side. Right: Postoperative lateral jaw roentgenogram of right side.

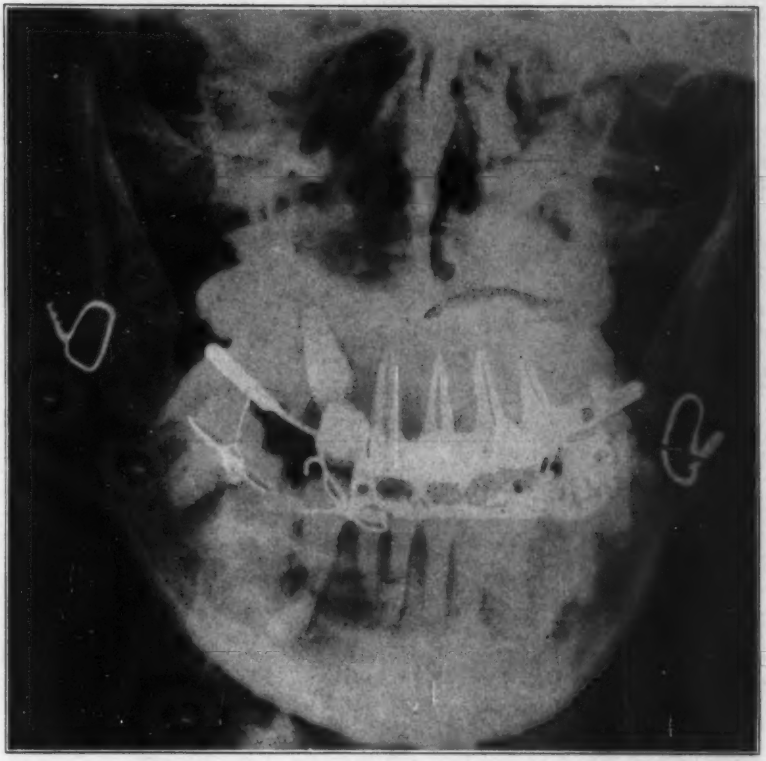

Fig. 18.—Case 3. Postero-anterior roentgenogram. The immediate postoperative occlusion was maintained for a period of several months, after which it became noticed that spaces were developing between the lower teeth and that the bite came end to end. There was an actual class III relationship of the teeth before it became evident that the spacing and displacement were in large measure due to an abnormal size of the tongue. This will be considered in future cases showing marked macroglossia.

approaching denture problems. Others have had unsatisfactory denture experiences and resort to this type of surgery for aid.

The majority of our cases have been cared for most satisfactorily by osteotomy of the rami by means of an open surgical approach from behind the posterior border of the rami through which manipulation, repositioning and fixation of the fragments under direct vision could be accurately accomplished. (Fig. 21.) The mechanics and considerations predetermining the result necessitate careful evaluation of examination findings.

Pertinent factors to consider in all cases are: Will the patient benefit sufficiently to warrant corrective surgery, as determined by the distance that

Fig. 19.—Case 4, aged 23 (1938). Reconstructed casts with cut out facial moulages to show surgical treatment of prognathism by excision of bone in the third molar region.

Fig. 20.—Case 4. Left: Mandibular prognathism with about three-sixteenths inch deviation to the right. Right: Postoperative photograph, showing the scar resulting from the low grade infection due to the retention of a portion of Penrose drain. Approximately five-eighths of an inch of bone was excised from the molar region on the right side and seven-eighths of an inch of bone from the left side.

the mandible is to be set back? Will the bite relationship in the posterior mouth need to be opened or closed to maintain occlusion postoperatively? How much lateral and rotation correction will be necessary? What is the true width of the rami (to help determine the maximum distance that the mandible can be set back and still remain within safe limits for bone contact)? What will be the angle of the osteotomy in relation to the arbitrary

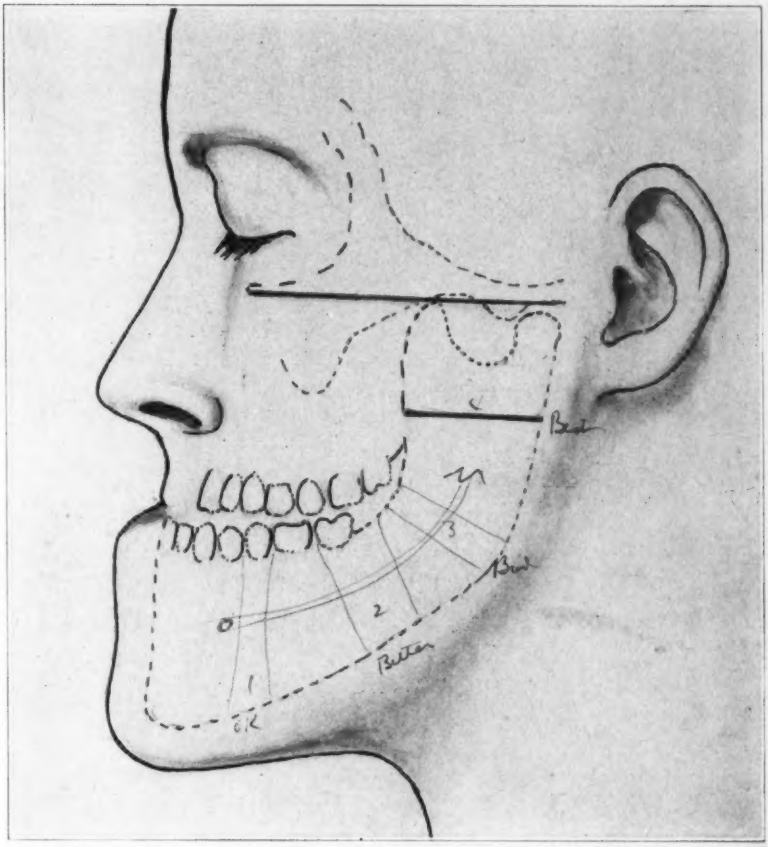

Fig. 21.—Profile chart, showing the Frankfort plane and the position of a parallel horizontal division of the ramus.

Frankfort plane? Will one or both rami be divided, and will one or both divided rami be butted or lapped? These are all important determinations to attain the best possible occlusion of teeth or jaw relation with reference to wearing dentures, to improve the esthetic and cosmetic effect in facial appearance and to establish an improved mental attitude. (Figs. 22-29.)

PROCEDURE

Osteotomies of the mandibular rami may be done under general anesthesia or local procaine anesthesia. All but three of our cases have been

Fig. 22.—Reconstructed casts with cut out facial moulages to show surgical treatment of prognathism by diagonal osteotomy of the rami. The body of the mandible was set back seven-eighths of an inch.

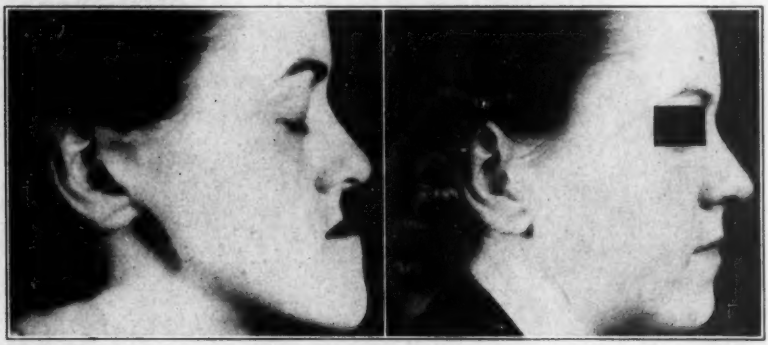

Fig. 23.—Case 5, aged 21 (1939). Bilateral osteotomy of the rami. The body of the mandible was set back 10 mm. Left: Preoperative profile. Right: Postoperative profile.

Fig. 24.—Case 5. Preoperative open bite prognathism, malocclusion.

Fig. 25.—Case 5. Postoperative occlusion has been maintained to date. Protrusion of the lower jaw was noticed at 6 years of age. This protrusion gradually increased, with a history of colds and mouth breathing. Tonsils and adenoids were removed at 12 years of age.

Fig. 26.—Case 6, aged 16 (1939). Unilateral deviation prognathism necessitating osteotomy of the ramus on right side only. Left: Photograph of occlusion before operation. Right: Photograph after operation. This patient subsequently developed a temporomandibular joint disability on the left side. It was relieved by the use of posterior occlusion splinting.

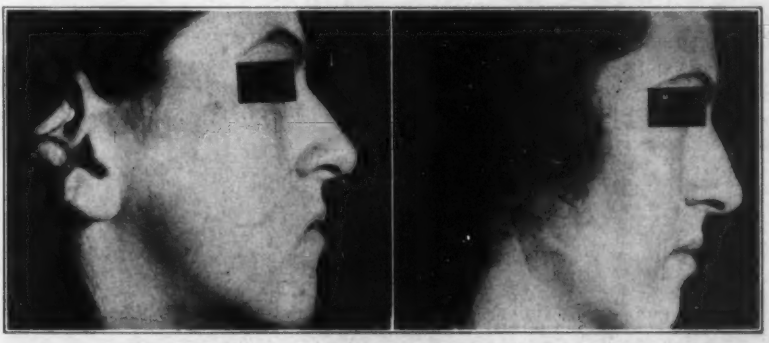

Fig. 27.—Case 6. Left: Profile photograph before operation. Right: Profile photograph after operation.

operated on satisfactorily under a local anesthetic, a method permitting complete immobilization of the jaws before the incisions are closed.

After all preliminary preparations and determinations, such as the grinding of teeth and the construction of splints, have been completed, an incision is made through the skin beginning at a point about 1 cm. behind and slightly below the attachment of the lobe of the ear and extending downward in a line parallel with the posterior border of the ramus for a distance of about one and one-fourth inches. If necessary, the incision may be placed farther back, depending upon the amount of setback. The parotid fascia is exposed by blunt dissection. The fascia and parotid gland are bluntly dissected and spread sufficiently to provide an adequately open field through which to work, and the periosteum along the posterior of the ramus is exposed. A straight line incision of the periosteum is made about one inch in length along the posterior border of the middle third of the ramus. The periosteum is then carefully separated and elevated from the external surface of the bone along the upper part of the ramus, including the anterior border. A small blunt hooked-end measuring instrument is passed upward until the mandibular notch is found. With this instrument resting in the lowest part of the notch, a chisel mark is made one-half inch below the notch. This mark represents the average distance below the notch above which the osteotomy can safely be made without severing nerve and vessels. The distance may vary from seven-sixteenths to ten-sixteenths of an inch, depending on the size and the contour of the mandible. Hensel states[1]:

The inferior alveolar nerve enters its foramen three-sixteenths of an inch or less below the spine of the lingula and is very close to the inner surface of the mandible for a similar distance above the lingula. These measurements make evident the small margin of error permissible at the site of osteotomy. Selecting a middle third of this measured distance, a safe osteotomy can be performed only within a field of three-sixteenths of an inch through the midlinear area (above the lingula). Whether osteotomy is transverse or oblique, the line of section crossing the midaxis of the ramus should always pass through this safe area. If the osteotomy is made too low, section of the inferior alveolar nerve and accompanying vessels surely will result. On the other hand, if division of the bone is carried too high, there is grave risk of splintering the upper portion of the ramus into the mandibular notch and so converting it into separated coronoid and condylar processes. The latter mishap invites displacement, disturbance of the temporomandibular joints, malunion and laterognathism.

The medial periosteum of the ramus is then separated and elevated from the bone above the chisel mark and forward to the anterior border. To make sure that the nerve and vessels entering the alveolar foramen are below the elevated periosteum, an instrument is carefully passed downward along the ramus to meet the interference of these structures. Above this point of interference, we know, is the area of safety through which the osteotomy

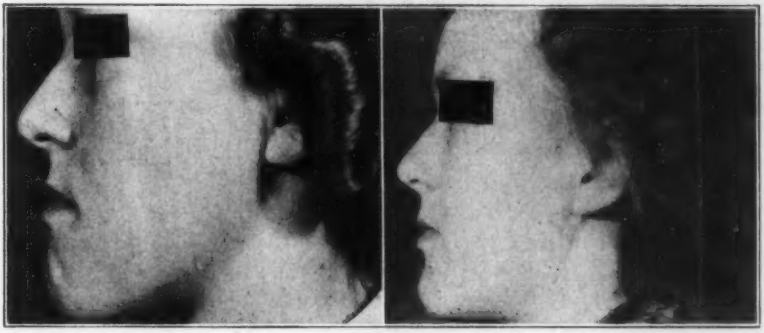

Fig. 28.—Case 7, aged 20 (1939). Open bite malocclusion with slight prognathism. Left: Profile photograph before operation. Right: Profile photograph after operation.

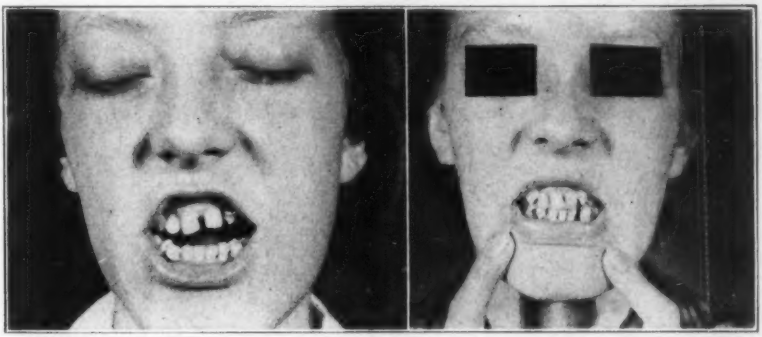

Fig. 29.—Case 7. Left: Lateral photograph of open bite malocclusion. Right: Occlusion after operation.

can be made without danger of severing the nerve or vessels. Usually this determination is about in line with our chisel mark, but any variation can be estimated when beginning the division of the bone. This is done by means of an ordinary Jacob's nasal saw, and the cut is made as predetermined in degrees of angle relative to the Frankfort plane, which is indicated by a line drawn across the face from side to side before the operation is begun. Aqueous mercurochrome or tincture, or any other staining solution is used, applied with the ordinary wood applicator. If direct wiring of the fragments is to be done, just before the bone is divided a small hole is drilled near the posterior border of the upper fragment if the mandible is to be set back (or at a comparative point in the lower fragment if the mandible is to be brought forward), and the wire is threaded through. Sometimes the second drill hole on the lower fragment can be made at this time if

the predetermined distance required for correction is not too great and adequate access by retraction is possible. It is generally advisable to drill the second hole after the lower fragment has been manipulated back with a forceps and is free to be moved the desired distance. The wire is threaded through this hole and left loosely twisted. We use either 24-gage virgin silver wire or 28-gage stainless steel.

The wound on the first side is packed with gauze and covered with dressing. When the holes have been properly drilled on the second side and the fragments manipulated free, the wire is threaded through the fragments. The prognathic mandible is forced back into the desired position and immobilized, the divided bone fragments being approximated with each other, butting or lapping as predetermined. At this stage in the procedure, an associate manipulates the teeth of the mandible into the desired occlusal relationship, where they are secured by tie wires from the mandibular to the maxillary appliance. A recheck is made of the amount of setback and the relationship of the fragments. The wire through the bone is then tightened on the second side and is twisted and bent to avoid irritating adjacent tissue. The fascia is closed with fine catgut suture and the skin with fine silk, a split Penrose drain being sewed in. The first side operated on is then reentered, the bone fragments checked for correct setback position, the wire tightened and the tissue closed in the same manner. Dressings are applied to both sides. During the operation, the procaine is injected ahead of the immediate operative field to ensure a minimum of discomfort at all times. When reentering the first side, it is necessary to reinject the anesthetic in the tissue to avoid too much discomfort in completing the procedure. Just before this reinjection, a check of the neurological effects of the facial nerve may be observed if some operative or retractor trauma has caused disturbance of the normal function of facial expression.

When using general anesthesia, caution is observed against immobilizing the mandible too securely because of the danger of postanesthetic nausea and vomiting. To reduce this possibility, we allow the patient to awaken just before immobilizing the mandible and then complete the procedure with local anesthesia. Recently, local procaine combined with pentothal sodium intravenous analgesia has proven most satisfactory. The mandible can then be adequately immobilized. If there is still any risk of postanesthetic difficulty, rubber bands rather than wires should be used for the first six to twenty-four hours. We are not fully satisfied, however, with our technic of osteotomy of the rami, which consumes too much time. We think that a type of small vibratory motor saw can be devised to facilitate and speed up the division of the jaw, changing our somewhat laborious procedure to one that is relatively simple. It may be stated that the freedom from operative complications such as hemorrhage as a result of our deliberate open view operation has had its reward from the standpoint of the imme-

diate postoperative course and the ultimate permanent result of the treatment.

After the operation, there is seepage of parotid fluid from the incisions. In a few cases this drainage ceased in three or four days, but in other cases it persisted on one or both sides up to twenty-three days. For the first few weeks after operation, the patient is kept on a bland diet to retard the function of the salivary glands. Abstinence from citrus juices and from unnecessary talking is advised until drainage of parotid fluid has completely subsided.

In a few cases, partial facial paralysis developed, in no case occurring bilaterally or persisting permanently. The facial nerve branches involved were the temporal, zygomatic and infra-orbital, paralysis of which prevented wrinkling of the forehead, raising of the eyebrow and closing of the eyelids. These neurologic effects resulted from operative trauma due to retraction of the tissues. An interesting phenomenon occurred in one case. A girl with paralysis on one side of the face was unable to close her right eye or wrinkle her forehead, but recovered about three months after operation. About two months later, she noticed that her eyelids seemed to close more than normal and that there was a noticeable lag in opening her right eye. This annoyed her for a few weeks, after which the eyelids and forehead functioned normally, except that now when she smiles the right eyelid has a tendency to close slightly.

We have not attempted the closed type of Gigli saw division of the ramus for four reasons:

1. It is difficult to pass the saw far enough above the inferior dental nerve and vessels to avoid injury and laceration. We have seen this happen several times, to the discomfiture of the surgeon, with the necessity of inserting through-and-through packing. The subsequent postoperative treatment obviously uses more time than would have been needed to perform the more painstaking open view operation.

2. It is our opinion that precision in the matter of the division of the ramus in the horizontal plane or variation from this plane to effect elevation or depression of the molar region or shortening or lengthening of the ramus would be difficult if not impossible to obtain by the closed Gigli saw technic.

3. More important is the fact that the setback of the body of the mandible to the desired occlusion may, in some cases, force the condyle ramus fragment to a more posterior position than normal, with some subsequent recurrence of prognathism and malocclusion.

4. No less important is the problem of the occasional interposition of tissue between the fragments, resulting in impaired or delayed union or, rarely, in nonunion with more or less disability and malocclusion.

On account of these considerations, it is our concept that open view operative procedure is indicated because the site and plane of division of

the rami can be perfectly controlled, the setback can be accurately effected and the apposition of the fragments assured under direct vision. This method permits direct surgical wiring of the fragments when necessary or advisable.

PROBLEMS OF STABILIZATION

Some cases present problems in stabilization of the mandible and maintenance of adequate immobilization for the desired period. The edentulous cases require upper and lower denture splints, which are constructed according to a predetermined plan for the repositioned mandible. We use upper and lower anterior teeth in clear acrylic denture splints of a modified Gunning type, with rest blocks supporting the posterior and adequate space just ahead to provide ample room for intake of food. These denture splints are wired together or held together with rubber bands on hooks, and the mandible is held up with an elastic sling to keep it immobilized in position.

In the partially edentulous case, modified splints and intra-oral wiring combined have been satisfactory. Whenever there are usable teeth, even though some may be carious, we feel that intra-oral fixation with wire is most satisfactory. In only one case was it necessary to resort to the use of a skeleton headcap, made of Aire Lite (Tower Company), for eight weeks. This patient had an edentulous upper and a partially edentulous lower jaw. His mouth and throat were extremely sensitive. Impressions were almost impossible to obtain, owing to gagging. We found, however, that when the upper denture splint was held firmly in the mouth, supported with two extra-oral bars attached to the headcap, he was relieved of his gagging. Several weeks of experiment were necessary before his operation. The mandible was immobilized to this splint with rubber bands connecting an anterior Jelenko arch bar to hooks on the upper denture splint. The patient had lower anterior teeth retained in extensive hyperplasia of the gum and upper artificial teeth in the upper clear acrylic denture splint.

Moose[2] has described a method of dividing the ramus through an intra-oral incision. The site of entrance of the inferior dental nerve and vessels is visualized, and the bone is divided at a higher level with an orthopedic power-driven short stroke cross-cut saw. There is no danger of hemorrhage to complicate the operative or postoperative course. The amount of setback before final suturing could well be determined, although Moose states that he sutures the first incision before proceeding to the opposite side, and he therefore has no assurance that the upper fragments have not been pushed back until subsequent x-ray examination reveals the position of the upper fragments. It may be difficult to divide the ramus in the horizontal plane if such is indicated, or in a predetermined variation from the horizontal plane. One might, however, be able to establish a technic that would make possible a precision type division in the operative mouth open position. This

2. Moose, S. M.: Correction of Abnormal Mandibular Protrusion by Intra-Oral Operation. J. Oral Surg. 3:304-310, October 1945.

method avoids any possibility of parotid gland or facial nerve complications, which however, occur but very rarely. There is no external scar, although in our experience this is no problem.

Hensel's[1] review of this subject is most comprehensive and worthy of study. His plan of direct surgical approach through the cheek is interesting, and the diagnostic predetermination of the line of angulation of the division is most exact. The planes of division indicated to correct various types of prognathic deformities, the displacements and related muscle activities are well illustrated. The resulting cheek scar is slight and apparently of no consequence. We have had no experience with this operation, and as we are able to visualize the entire external surface of the mandible forward to its anterior border through the posterior incision, we have not tried this cheek approach for fear of injuring the facial nerve or the parotid gland or producing an unsightly scar. Previous experience with circular saws in bone grafting the mandible also discouraged us from trying this method.

Smith and Johnson[3] have advocated the removal of a quadrilateral section of bone below and including the mandibular notch. Division of the base of the condyle in line with the level of the excision permits setting back the jaw and brings the coronoid process in contact with the condyle. This obviously changes the relationship and direction of pull of the temporal muscle, and for this reason in particular we have not tried this method.

SUMMARY

Our concept of the surgical problems of the treatment of the various types of mandibular prognathism is presented in order to stimulate interest in this subject and to promote discussion from a fundamental surgical standpoint. We feel that the seriousness of this operative procedure warrants careful preoperative study and the adoption of a technic that is free from complications and that will ensure a high percentage of permanent corrections of the deformity. It is our opinion that an open view operation is essential in order that the predetermined distance of the setback of the jaw may be obtained without displacement of the upper coronoid condyle fragment.

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Current Literature

CYSTS OF THE FLOOR OF THE MOUTH. W. H. Johnston.

The author, in a review of the literature on the subject of cysts of the floor of the mouth for the past quarter century, found that of more than fifty-three articles, the majority had European sources and were contributed by stomatologists and dentists. Cysts may develop on or in the floor of the mouth or may involve it secondarily. They may be either congenital or acquired and of many types, including ranular, dermoid, epidermoid, thyroglossal, branchial, mucous, hydatid and ectatic of the salivary ducts. The author states that there seems to be no satisfactory classification available which includes all possible cysts of this region.

The sublingual, submental and mental structures are built up from so many embryonal structures that developmental errors, inclusions and deformities are apt to occur. The fusion of the mesial ends of the upper four branchial arches may result in portions of epithelium being pushed into the depths, especially in the midline. Such displaced epithelium retains its embryonic vitality and may at any time develop into a cystic formation. The cephalic intestine also enters into the formation of the floor of the mouth; which accounts for the many types of epithelial cells found in congenital cysts of this region. The cervical sinus and duct, with its complicated system of epithelial chambers which ordinarily become obliterated and disappear, may, however, have a portion left behind from which cysts or fistulas may develop.

Cysts of the floor of the mouth are relatively infrequent, grow slowly, and are round or ovoid, and the symptoms depend on their size and positions. Difficulties in speech, swallowing and mastication gradually increase with the enlargement of the cyst. Large cysts tend to deform the mandible, and may, if neglected, cause respiratory obstruction. Though the diagnosis of the type of cyst may be somewhat difficult, this, the author believes, is not particularly important since all cysts, regardless of their origin, should be removed surgically. He condemns aspiration for the purpose of studying the contents because of the danger of infection. Cysts may become infected, with resultant cellulitis and abscess formation.

Differential diagnosis is ordinarily not difficult. Lipoma, fibroma hemangioma, carcinoma, sarcoma, and cystic lymphangioma should be excluded.

Certain congenital cysts, though not actually in the floor of the mouth, may, when very large, encroach upon this region. Those of Bochdalek ducts, and thyroglossal ducts and branchial cysts may thus involve the floor of the mouth. Branchial tumors developing in the sublingual or submaxillary salivary glands may appear as cysts of the floor of the mouth. Dermoid cysts from the first cleft, though rare, may appear on the under surface of the tongue and tend to grow rapidly at the time of puberty or in early adult life. The wall is fibrous and thick, with a lining of stratified epithelium and with contents of the usual dermoid type, hair or other skin appendages. The author discusses the theories of origin and the opinions of a great number of contributors to the literature on the subject. The majority recommend external approach for

the radical removal of the cyst. The use of escharotics to destroy the cyst lining is condemned.

Epidermoid cysts are lined with epithelium of the mucous type. They usually occur in the elderly. Surgical removal is the only treatment recommended.

Occlusion of the ducts of any of the numerous mucous glands of the floor of the mouth is followed by retention of secretions and dilatation of the duct to produce a very thin wall adhering to the mucosa. The glands may show regressive changes from pressure of the cyst. Total excision is desirable, but enucleation is difficult on account of the thinness of the wall.

Ranulas appear in the sublingual region and are usually unilateral. A great deal of confusion is evidenced by the author's review of the literature on matters of origin, inflammatory considerations, etiologic classification and methods of treatment. While complete enucleation is recommended, suturing of the cyst wall to the margins of the incision of the oral mucosa to make the cyst an accessory cavity of the mouth may be indicated on account of the difficulties in removing a thin-walled cyst.—*Ann. Otol., Rhin. & Laryn.*, 51:917-930, December 1942.

AGRANULOCYTOSIS ASSOCIATED WITH SULFADIAZINE THERAPY. Edmund B. Flink and Theodore E. Bratrud.

Sulfadiazine, in the authors' experience, is a useful chemotherapeutic agent with less toxic reactions than those from sulfanilamide, sulfapyridine or sulfathiazole therapy. An infrequent type of reaction associated with sulfadiazine is a decrease in the total leukocyte count from high or normal values to below 4,000 cells per cubic millimeter.[1, 2] Agranulocytosis has been reported to have followed the use of sulfanilamide, sulfapyridine or sulfathiazole.[3, 4, 5, 6] A review of the literature indicates that there is only a single case of agranulocytosis reported as due to sulfadiazine therapy.[7] The case was not fatal. It appears that agranulocytosis is an extremely rare complication of sulfadiazine therapy. The following case report is presented as an instance of acute agranulocytosis with a fatal outcome occurring during the course of treatment with sulfadiazine in a patient with subacute bacterial endocarditis. This is the only fatal case of agranulocytosis at the university hospitals following the use of any of the sulfonamides.

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REPORT OF CASE

A woman, aged 28, had apparently been in good health until five months before admission, at which time she was seven months pregnant. Increasing weakness and night sweats were noted, but no fever or chills. Labor was uneventful and a normal child was delivered. The condition of the patient did not improve. She lost weight and, five days before admission, developed a purpuric rash and edema of the feet. The history was negative except for scarletina at the age of 10 and a diagnosis of "leakage of the heart" at age 15. There was no history of rheumatic fever.

Examination revealed a temperature of 99.8° F., pulse 104, and an enlargement of the heart, with harsh systolic and soft diastolic murmurs. During the next two weeks, the heart murmurs became louder and higher pitched and there was hematuria, with pain in the left flank, interpreted as due to a renal infarction. Sulfadiazine was given intra-orally, but only intermittently because of the accumulation of the drug in the blood and an inability to insure an adequate volume of urine. The effect of the sulfadiazine therapy on the leukocyte count was checked frequently. The patient received 2,000 cc. of whole citrated blood and erythrocytes suspended in a physiologic sodium chloride solution derived from 2,100 cc. of whole blood. The white blood count increased to 9,500 at the end of one month, but dropped to 4,250 a week later. Two days later, the count was 950, with a differential count of neutrophils, 42; lymphocytes, 56; monocytes, 2. The sulfadiazine was promptly discontinued. The drug had not afforded any clinical benefit, there being a constant fever up to 102° F. Death occurred four days later and the leukocyte count was down to 500, with complete absence of neutrophils.

The necropsy findings were: acute agranulocytosis; patent interventricular septal defect; subacute bacterial endocarditis of the pulmonary valves; pulmonary conus of the right side of the interventricular septum; right ventricular hypertrophy with dilation; pulmonary infarcts; bilateral pulmonary edema; bronchopneumonia, and chronic passive congestion of the liver, spleen and kidneys.

SUMMARY

A case of subacute bacterial endocarditis is reported in which acute agranulocytosis developed twenty days after instituting therapy with sulfadiazine. The total dose was 54 grams, given over a period of twenty days. The sulfadiazine appeared to have caused the agranulocytosis because no other drugs were administered immediately prior to the onset of the agranulocytosis.—*Minnesota Med.*, 26:898-899, October 1943.